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THE AGE AND GROWTH OF TROUT IN NEW ZEALAND.

(PAPER No. 1.)

BY

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PREFACE.

As Numbers 2 and 3 of this series of Fisheries Bulletins the Marine Department published reports by Captain J. S. Phillips dealing with the food and other conditions affecting the well-being of trout in certain New Zealand waters.* In the paper that follows Mr. Parrott presents a study of trout problems from an equally important but entirely different point of view. In both cases the general problem is the determination and comparison of the value of certain waters for the production of trout. We may compare the process with the comparative study of different farm lands. One investigator may study the character and composition of the soil and enumerate the qualities and quantities of the different grasses, &c., that are found on it. Another investigator, considering the effects of these factors by way of production, deals with the number of head of cattle or sheep that can be carried per acre and the yield of butterfat or wool.

It is with this latter kind of evaluation that Mr. Parrott's investigations into the growth and age of trout are more or less analogous. In the study of fish-life, whether causes or effects are the subject of investigation, the factors are usually obscure, and their elucidation is a matter of some difficulty. Mr. Parrott's work may be described as a scientific analysis of the effects of different environments on trout with regard to the production of that quality which is of most importance to the average angler—namely, size. Those whose duty it is to maintain and, if possible, improve the fresh-water fishing of the Dominion must aim at providing the maximum quantity of trout per acre of water; and it is clear that the ability to determine the amount of growth which a fish has undergone for each year of its life will throw very valuable light on the problem. The question may be made clearer by taking concrete examples. Suppose, for instance, that the trout in a certain river show rapid growth for the first three years and after that the increase is below the general average increment for the fourth and fifth years of a trout's normal growth. It will be evident that food-supplies for big fish are lacking. If, on the other hand, the early growth is not up to the average it indicates a shortage of suitable food for the small fish, and suggests the possibility that overstocking has taken place.

A further example of the utility of scale-reading may be illustrated by an analysis of the age of a representative sample of the trout from a river which shows, for instance, in the year 1929 a large preponderance of four-year-olds, in 1930 a preponderance of five-year-olds, and in 1931 still a majority of the same generation, now six-year-old fish, with comparatively few of younger generations. This is an indication that there was a good production of fish from the spawning season of 1925, and that subsequent spawning seasons have been comparative failures. With this indication to go upon, one would proceed to look into the conditions which made 1925 a much better year than the others for the reproduction and survival of a new generation. The understanding of the conditions to which scale-reading affords the key would be a help in deciding policies of stocking, for it is clear that

* Phillips, J. S.: "A Report on the Food of Trout and other Conditions affecting their Well-being in the Wellington District" (1929). *Id.*: "A Further Report on Conditions affecting the Well-being of Trout in New Zealand" (1931).

where natural reproduction is subject to frequent failures artificial stocking is more of a necessity for the maintenance of good fishing. And it is equally clear that a method of investigation that will enable us to throw light on the effects of artificial stocking, by way of comparative survival and growth, will be of considerable practical value.

Other illustrations of the application of scale-reading to practical problems might be added, but it will be obvious to the reader that the possibility of being able to determine the age of a trout is as fundamentally useful to a pisciculturist as the ability to ascertain the age of a sheep or a horse is to an agriculturist.

A more complete general discussion of the subject of scale-reading is given in the Marine Department's Report on Fisheries for the year 1929–30 (pages 44–48).

In conclusion, I may draw attention to the fact that this report by Mr. Parrott is necessarily of a preliminary nature, and its results are therefore indicative rather that conclusive. When further data have been acquired and incorporated into his scheme of study it will be possible to formulate conclusions which will throw light on our trout fisheries which will be not only of immediate practical significance, but which will remain as records of considerable importance to future students and administrators of the fresh-water fisheries of the Dominion.

A. E. Hefford.

Marine Department, Wellington, 10th December, 1931.

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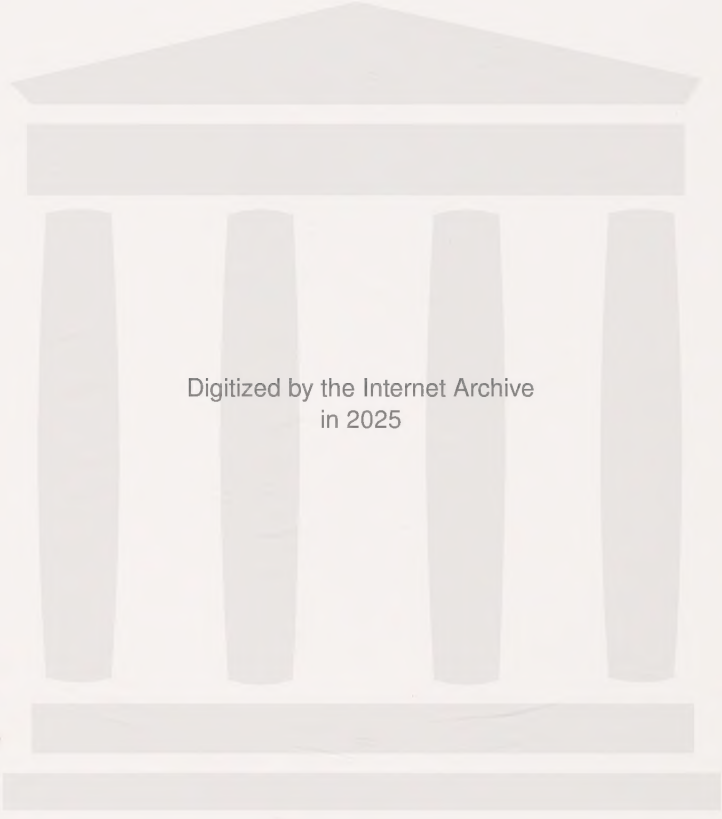
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The Age and Growth of Trout in New Zealand.

(Paper No. 1.)

I.—INTRODUCTION.

In 1929, at the time the New Zealand acclimatization societies formed and financed a committee to inquire into problems affecting the well-being of trout in the rivers and lakes of the Dominion, a scheme of research was drawn up and afterwards submitted to and approved by the committee. The present contribution forms a part of the general programme and is the first of a series dealing with the age and growth of the Salmonidæ in New Zealand.

As it will be several years before sufficient material has been obtained for a comprehensive study, it is proposed to issue from time to time, as far as it is possible with the material at hand, contributions to the various phases of the work. The thoroughness with which each sample may be usefully studied and the significance of the results depend upon the material available. It will therefore be desirable to review the work at intervals, with a view to determining the degree of deterioration, if any, in the various trout waters, and to the elucidation of certain aspects of their life-history, upon a knowledge of which it is essential to base conservational methods. The inference of definite conclusions must therefore be deferred until further data are obtained and incorporated with this preliminary material. The present report should be considered as an interim one, especially in regard to the Sumner district, which is dealt with in the beginning because, although not so comprehensive as is desirable, it serves very well to illustrate the various growth-types.

Individual variability in growth is brought about mainly by differentiations in habits, which in turn are directly affected by outside influences, such as overcrowding, scarcity of food, overfishing, conditions affecting spawning, &c., and inside influences such as inherent characteristics of the individual fish.

Many more fish will have to be examined, and final analysis and comparisons made before we are in a position to state the causes of these variations in growth that take place in the trout. We are at present, so to speak, endeavouring to analyse the effects, in the hope that such analysis will throw light upon the causes. For the present we have to concentrate upon the actual growth data, presented in the following pages, and the only conclusions we can arrive at from such data are those associated with the actual growth, which may be regarded as the visible effects of unknown causes.

The only previous work on the growth of trout in New Zealand is that of Godby(3) in which is included a careful analysis of brown-trout samples obtained from the Lower Selwyn River during 1915, 1917, and 1918, and smaller samples from other localities in Canterbury.

II.—BROWN TROUT FROM LAKE SUMNER DISTRICT, SEASON 1929–30.

Of the twenty-nine sets of scales on which this chapter is based, Lake Sumner contributed ten, Lake Shepperd seven, Loch Katrine five, Lake Raupo three, Hurunui River three, and the Sisters Stream one. All except two from Loch Katrine, which were collected during the season 1927–28, were collected in 1929–30.

Age.

In the following table (No. 1) are given the average lengths, weights, and ages of the fish from the various localities.

In none of these tables is the uncompleted year (the season during which they were caught) included. The reason for this is that it is very doubtful at what time of year exactly these fish spawned; and unless we know approximately in what month spawning has taken place and at what time of year the winter band is completed the period of time represented by the zone outside the last winter band cannot be accurately determined. In the following table (No. 1) the age in each case is therefore slightly underestimated.

Table No. 1.

Locality.	Number of Fish.	Average Length.	Average Weight.	Average Age.
		In.	lb. oz.	Winters.
Lake Sumner ..	10	17·9	2 4	4·7
Lake Shepperd ..	7	23·3	3 10	5·8
Loch Katrine ..	5	22·6	3 12	6·4
Lake Raupo ..	3	24·6	4 12	6·6
Hurunui River ..	3	24·5	4 3	6·1
Sisters Stream ..	1	5	?	1·0

The largest and oldest fish were taken from Lake Raupo. It should be noticed that, although on an average larger than those from Loch Katrine, the Hurunui and Shepperd fish are younger.

Table No. 2 gives the number of fish from each locality with their corresponding age and year of birth.

Table No. 2.

	Number of Fish caught during their							Total.
	Second Summer.	Third Summer.	Fourth Summer.	Fifth Summer.	Sixth Summer.	Seventh Summer.	Eighth Summer.	
Year of Birth ..	1928.	1927.	1926.	1925.	1924.	1923.	1922.	
Lake Sumner ..	1	1	1	1	2	2	2	10
Lake Shepperd ..	..	..	..	..	3	1	1	5
Loch Katrine ..	..	..	..	..	1	1	3	5
Lake Raupo ..	..	..	..	..	..	2	1	3
Hurunui River ..	..	..	..	..	1	1	1	3
Sisters Stream ..	1	..	..	..	..	..	..	1
Total ..	2	1	1	1	7	7	8	27

The two fish caught during the season of 1927–28 were in their eighth summer; their year of birth therefore was 1920. These are, of course, not included in the table. The majority were hatched during the spring

of 1922, 1923, and 1924. If this holds good with larger samples collected over a number of seasons, we may presume that these were favourable breeding seasons. In the present sample this occurrence may probably be due to the inadequate number examined. It will also be seen that fish under five years old were available only from Lake Sumner and the Sisters Stream. These facts should be kept in mind when dealing with their rate of growth in the following pages.

Rate of Growth.

In an appendix at the end of this paper I have arranged in tabular form (Table A) the length and weight when caught, sex, and age, together with the calculated length attained at the end of each winter for each fish.

Table No. 3 which is calculated from the Table A in the appendix, gives for the different localities the average length for each consecutive winter through which the fish have lived.

Table No. 3.

Locality.	Average Calculated Length in Inches at End of Winters.							Mean Increments per Year.
	1.	2.	3.	4.	5.	6.	7.	
Lake Sumner ..	4·6	8·8	12·8	16·7	19·3	21·2	22·8	3·25
Lake Shepperd	5·4	9·8	14·3	16·8	19·7	22·2	23·2	3·31
Lake Raupo ..	4·6	7·3	11·9	16·0	20·0	22·0	24·3	3·47
Loch Katrine ..	5·1	8·5	13·2	17·1	19·6	21·3	22·6	3·22
Hurunui River..	5·9	9·6	15·0	17·1	21·0	23·0	23·7	3·30
Sisters Stream ..	4·5	..	..	..	..	..	..	..

The growth curves in Graph No. 1 are plotted from these averages. The average rates of growth of the trout from the different localities agree pretty closely. It should be noticed that although the Raupo fish have the highest average increment per year, the Hurunui fish actually grew faster during their first three years. The average rate of growth is shown in Fig. 1 (p. 13).

Variability of Growth.

In the British Isles and Norway it has been shown that a change to rapid growth takes place after migration to the sea or to a lake. Very little has been published about the habits of the trout in New Zealand. Godby(3) associates changes to a more rapid growth-rate with migration to a lake or to the sea, and mentions that such a migration may first take place at an earlier or later stage in life. He deals with the case of trout in Lake Marymere, which has no streams flowing into it or out of it, and in which the trout must spawn in the lake itself. The scales of trout from this lake nevertheless show a marked increase in growth in the second year. The following explanation is suggested by Godby. "It must be remembered, however, that the insects in our back-country districts are mostly large in size, and it seems probable that the true explanation is to be found in the fact that the main bulk of the food-supply is of a nature more suitable to fish after they have passed the yearling stage."

The word migration will be used in this paper to mean any change in the habitat, whether to lake, estuary, or sea, or merely from the shallow spawning or nursery area to the deeper parts of the same river. In the latter case it may only be for a distance of a few hundred yards.

It is possible, and for practical purposes very convenient, to analyse the results given in Table No. 3 into certain classes or growth-types, as follows :—

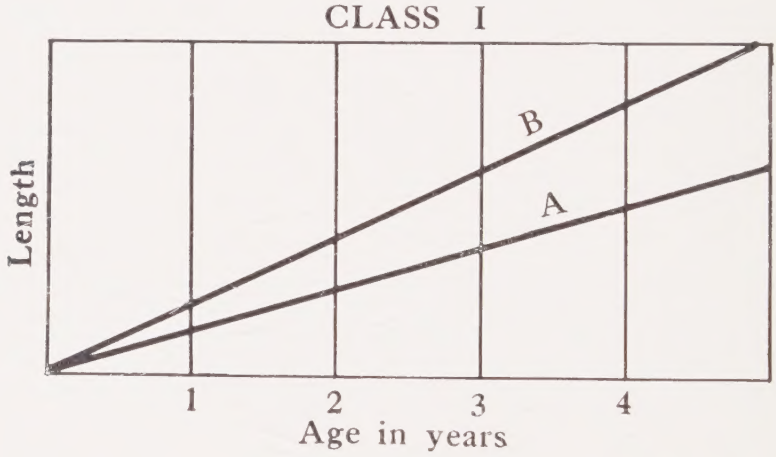
Class I includes those fish that have grown more or less uniformly throughout life. There are two types in this class—

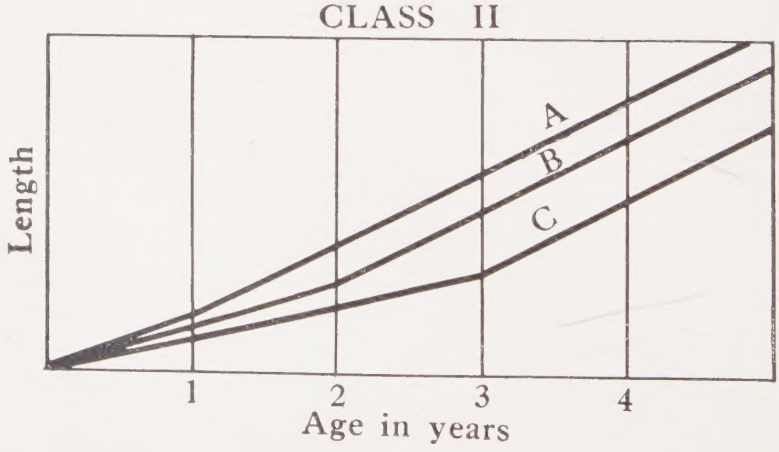
Type A. Growth relatively slow.
Type B. Growth rapid.

Class II : This class includes fish which show uneven growth—

Type A. Slow growth during the first summer, after which rapid growth takes place during one or more years.
Type B. Those individuals which not until the third summer show accelerated growth.
Type C shows slow growth for the first three years of life, after which rapid growth takes place during the fourth year.

These five growth-types may be represented diagrammatically as follows :—





The value of this method of analysis will be more apparent at a later stage in these investigations, when it will be possible to refer an individual scale-reading for comparison with the average growth-rate of the corresponding type for the same or different trout waters.

For example, a hypothetical case may now be considered. A fish from river X has the following growth-rate (Type Ia) :—

End of winters	1.	2.	3.	4.
Length, in inches	5	8	11	13·5

We wish to compare the growth of this fish with that shown by the trout taken from the River Y.

The general average for River Y is as follows :

End of winters	1.	2.	3.	4.
Length, in inches	4·5	10	14	16

This comparison shows the X fish to be distinctly inferior. The average for River Y, however, is affected by the dominance of fish of growth-type IIa—namely, fish which had migrated to more favourable surroundings at the beginning of their second year.

Since our River X fish belongs to growth-type Ia—*i.e.*, non-migratory—we must restrict our comparison to the non-migratory type of River Y, the characters of which represent the effects of a life lived continuously in the more or less uniform environment of the same river. We find that the growth-type Ia of the River Y gives the following average :—

End of winters	1.	2	3.	4.
Length, in inches	4	7	10	12·5

We may thus form the conclusion that, although the general stock of River Y have a greater average size for the same age, nevertheless the portion belonging to the Ia type (assumed to be resident, non-migratory individuals) show a deficiency in growth compared with the individual case from River X. Similarly, in comparing general samples of the stock from different waters it lends greater significance to the results if like types are compared. There are odd individual cases showing an intermediate or border-line character in which assignment to a particular class or growth-type has to be somewhat arbitrary, but the proportion of such cases is very small.

The relative numbers of fish included under each of these three types occurring in a river or lake is important for the elucidation of problems connected with their life-history and with the suitability of a particular body of water for the promotion of their growth.

In the following table fish from each locality are assigned to the various classes defined above.

TABLE No. 4.

Fish classified according to Type of Growth.

Class	I.		II.		
Type	A.	B.	A.	B.	C.
Lake Sumner	2	2	3	2	..
Lake Shepperd	..	2	2	2	1
Loch Katrine	..	3	1	1	..
Lake Raupo	..	1	..	1	1
Hurunui River	..	1	..	1	1
Total	2	9	6	7	3

From the above table it will be seen that approximately 7 per cent. showed slow even growth, 33 per cent. showed even but fast growth, 22 per cent. grew rapidly during their second summer, 26 per cent. did not commence to grow rapidly till their third summer, and 11 per cent. did not show very rapid growth till after their third summer. Fig. 2 (p. 13) gives a graphical representation of this table.

There is thus considerable variation in growth-type in the stock of each of the waters sampled; or, in other words, the fish do not all migrate at the same age. The predominant types of growth, however, are IB, IIA, and IIB.

The following table (No. 5) gives the mean length, standard deviation, and coefficient of variation at the end of each winter through which the fish have lived:—

TABLE No. 5.

Winters	1.	2.	3.	4.	5.	6.	7.
Mean length (inches)	4·98	8·93	13·44	16·44	19·76	21·93	23·25
Standard deviation	1·06	1·65	3·56	2·77	1·03	0·96	0·65
Coefficient of variation	21·20	17·23	26·48	16·84	5·21	4·37	2·79

There are indications that there is less variability in the size of fish of the same age after four years have been reached. The cause of the greater variation in the younger fish is due to their more erratic, but, on the average, faster, growth during their first four or five years of life. Although not included here, the variability of the actual yearly increments showed a higher coefficient of variation for the second and third years than for the other years of growth.

YEAR CLASSES.

In the following table are given the average rates of growth for the various year classes.

TABLE No. 6.

Year Classes.	Number of Fish.	Length, in Inches, attained at the End of Winters.						
		1.	2.	3.	4.	5.	6.	7.
1928	2	4¾	..	..	..	..	..	..
1926	2	5	8¾	12½	..	..	..	..
1923	2	5½	8½	11¼	15¼	..	..	..
1924	5	4¼	8½	13½	17	19¼	..	..
1923	7	4½	9¼	13½	17½	20½	22¼	..
1922	11	5¼	8¼	13½	17½	20	21½	23¾

The growth for any year of life varies but slightly in the different year classes.

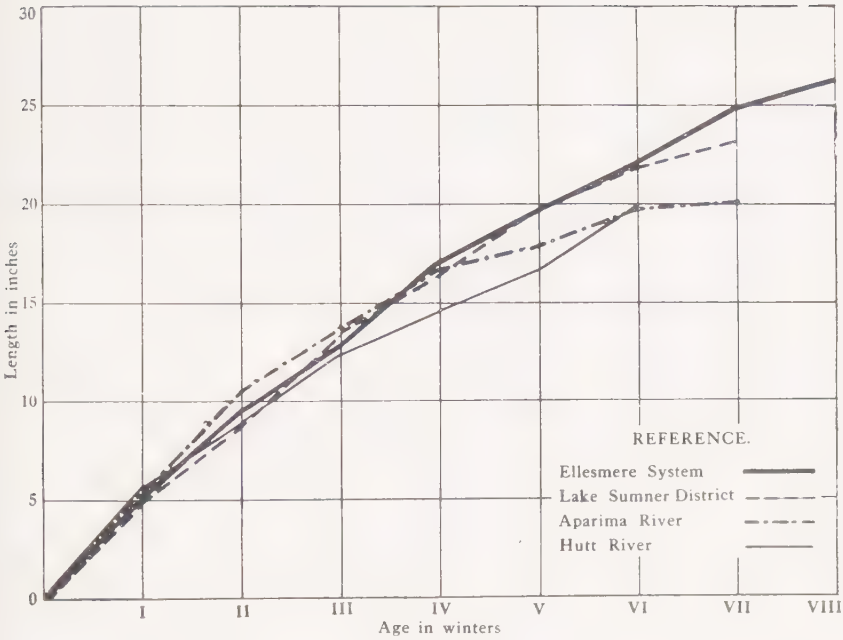

30
25
20
15
10
5
0
Length in inches
I
II
III
IV
V
VI
VII
VIII
Age in winters
REFERENCE.
Ellesmere System
Lake Sumner District
Aparima River
Hutt River

FIG. 1.

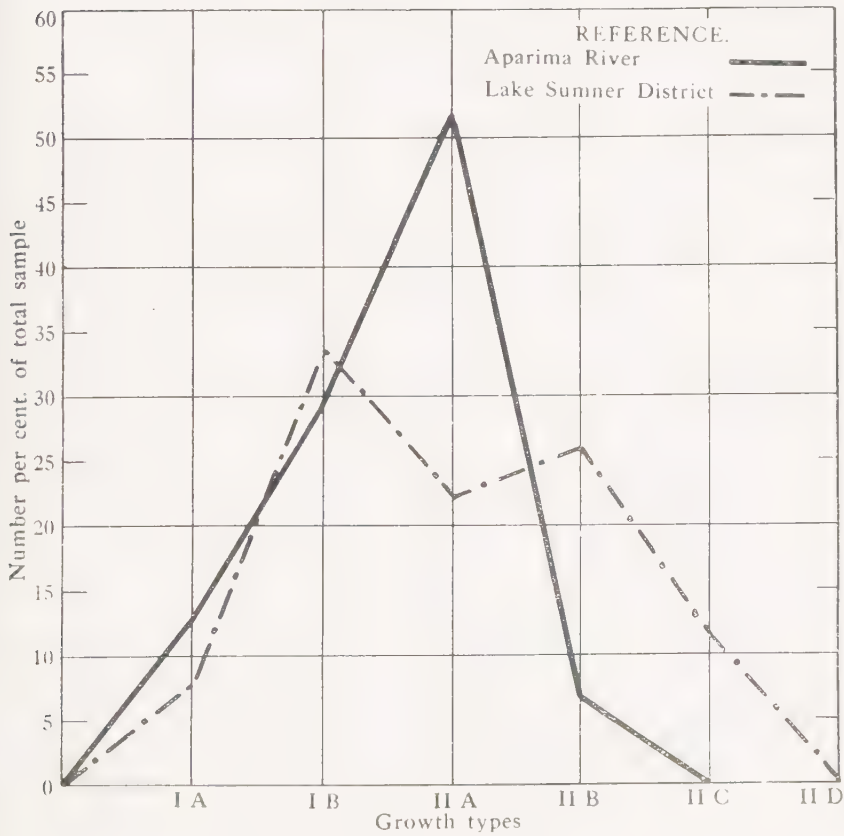

60
55
50
45
40
35
30
25
20
15
10
5
0
Number per cent. of total sample
I A
I B
II A
II B
II C
II D
Growth types
REFERENCE.
Aparima River
Lake Sumner District

FIG. 2.

Condition.

The fish considered in this paper were on an average in poor condition. As the "condition factor" is merely a figure expressing the relation of weight and length*, in examining the present figures it will be of interest to note that 42 is given as an average C.F. for the trout of the River Test (England), while in New Zealand rivers the average for the Selwyn is 45·5; Main Drain, 41·2; Mataura River, 45; and Rakaia River, 45.

In Table A in the appendix the length, weight, sex, age, and condition factor (C.F.) for each fish are given.

The following table (No. 7) shows the average C.F. for the different ages at which the fish were caught. In the extreme right-hand column the mean C.F. is given for each locality.

Table No. 7.

Locality.	Average C.F. of Fish caught during their					Average.
	Fourth Summer.	Fifth Summer.	Sixth Summer.	Seventh Summer.	Eighth Summer.	
Lake Sumner ..	31	39	35	39	27	34·2
Lake Shepperd ..	..	..	36	34	32·6	34·2
Loch Katrine ..	..	..	35	30	33	32·6
Lake Raupo ..	..	..	..	32	33	32·5
Hurunui River ..	..	..	33	34	21	29·3
Average ..	31	39	34·7	33·8	29·3	33·4

The fish obtained from Lake Shepperd have the highest C.F. (34·3); next comes Lake Sumner, with an average C.F. of 33·7. The Hurunui fish have the lowest average C.F. This is probably due to the inclusion of an entremely poor-conditioned fish which had a diseased heart; this fish had a C.F. of 21.

Summary.

1. Fish of the highest average age were obtained from Lake Raupo.

2. The average age of twenty-nine fish at the end of their last winter was 5·5 years. (The uncompleted year is ignored.)

3. Although the difference in the rates of growth of the fish from different localities is insignificant, the mean rate appears to be highest in Lake Shepperd and the Hurunui River.

4. The fish may be divided into several groups according to their mode of growth.

5. The variability in length of fish of the same age appeared to be greatest during the first four or five years of life.

6. There is very little difference between the average rate of growth in the different year classes.

7. The fish on an average were in poor condition, the mean condition factor being 32·4. The fish of the best average condition were taken from Lake Shepperd.

* The formula is C.F. $= \frac{W \times 100000}{l^3}$, where W = weight in pounds and l = length in inches.

III.—BROWN TROUT FROM THE ELLESMERE SYSTEM (CANTERBURY) FOR THE SEASONS 1927-28, 1928-29, AND 1929-30.

The material which forms the basis of this chapter was collected during the seasons 1927–28, 1928-29, and 1929–30 in what may be conveniently and appropriately called the Ellesmere system. For the purpose of the present paper the rivers and streams which comprise the above system may be stated to have two characteristics in common. They all flow into Lake Ellesmere, which is brackish, being situated adjacent to the coast, immediately south of Banks Peninsula. The lake is separated from the sea by a narrow shingle-bank through which an outlet is made periodically to the sea. The brown trout inhabiting this system, generally speaking, possess well-marked local characteristics.

The rivers in the Ellesmere system from which material has been obtained are the Selwyn River, "Number Two Selwyn Stream," Kaituna Stream, and Hart's Creek.

The following table gives the number of fish examined for each season from each of the above-mentioned rivers.

TABLE NO. 8.

Locality.	Season.			Totals.
	1927–28.	1928–29.	1929–30.	
Selwyn River	17	20	23	60
Number Two Stream ..	5	6	13	24
Kaituna Stream	2	..	..	2
Hart's Creek	..	..	7	7
Totals	24	26	43	93

The average age, length, weight, and the number of each sex for each sample may be read from Table No. 9.

TABLE NO. 9.

Season.	Average Length.	Average Weight.	Average Age.	Number of Males.	Number of Females.
		Selwyn River.			
	In.	lb. oz.	Years.		
1927–28 ..	15·7	1 15	3·3	10	7
1928–29 ..	18·6	3 11	4·0	8	12
1929–30 ..	14·8	2 1	2·9	11	12
Means ..	16·4	2 9	3·4	..	..
Total ..	..	..	..	29	31
		Number Two Stream.			
1927–28 ..	18·1	3 9	3·8	3	2
1928–29 ..	21·6	5 14	5·8	3	3
1929–30 ..	20·8	5 11	4·8	4	9
Means ..	20·1	5 0	4·8	..	..
Total ..	..	..	..	10	14
		Kaituna Stream.			
1927–28 ..	22·4	5 2	5·5	2	..
		Hart's Creek.			
1929–30 ..	22·5	5 4	5·0	2	5

From Table No. 9 the average age of the samples may be read. Unfortunately the material is not representative of the actual trout population in those streams, and consequently these average ages may be altered by the inclusion of further data.

Age.

The age composition of the samples is shown in Table No. 10.

Table No. 10.

Caught during ..	Second Summer.	Third Summer.	Fourth Summer.	Fifth Summer.	Sixth Summer.	Seventh Summer.	Eighth Summer.	Ninth Summer.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Selwyn River ..	11·6	16·6	15·0	38·3	11·6	6·6	..	..
Number Two Stream	..	4·1	12·5	29·4	33·3	8·4	..	15·5
Kaituna Stream ..	..	..	..	..	50·0	50·0	..	..
Hart's Creek ..	..	..	..	28·5	42·8	28·5	..	..
Ellesmere system	7·5	11·8	12·9	34·4	20·4	9·6	.	3·2

From Table No. 10 it will be noticed that the predominant age was four (completed) years.

It is interesting to note that there are two main groups, one with its lower and upper limits as two years and eight years respectively with a mode at five years, and the other groups with a lower limit at three years and an upper limit at nine years with its mode at six years. The first group comprises fish from the Selwyn River, and in the second group are included all those fish taken in the Ellesmere system exclusive of the Selwyn River.

Rate of Growth.

The following tables (Nos. 11 and 12) give the average growth-rate of the fish from the various streams during each season.

Table No. 11.

River.	Season.	Length, in Inches, attained at end of Winters.							
		1.	2.	3.	4.	5.	6.	7.	8.
Selwyn ..	1927–28	4·9	8·8	12·4	15·8	17·8	20·2	.	..
	1928–29	4·7	8·9	12·4	15·8	18·5	19·7	..	..
	1929–30	4·8	8·4	12·9	16·2	19·6	..	..	..
Number Two Stream	1927–28	6·2	10·8	15·1	17·3	17·2	..	..	..
	1928–29	5·0	9·1	12·1	15·5	18·6	22·1	25·0	26·5
	1929–30	5·3	10·7	14·7	18·0	19·9	22·7	24·5	26·0
Kaituna Stream ..	1927–28	5·1	8·2	11·8	17·7	20·2	22·2	..	..
Hart's Creek ..	1929–30	5·1	8·8	14·0	17·7	21·4	24·0	..	..

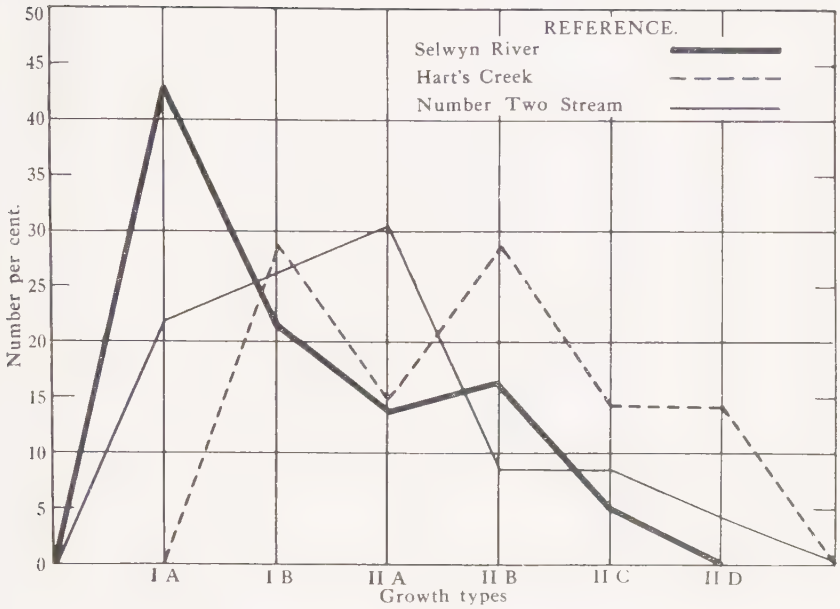


FIG. 3.

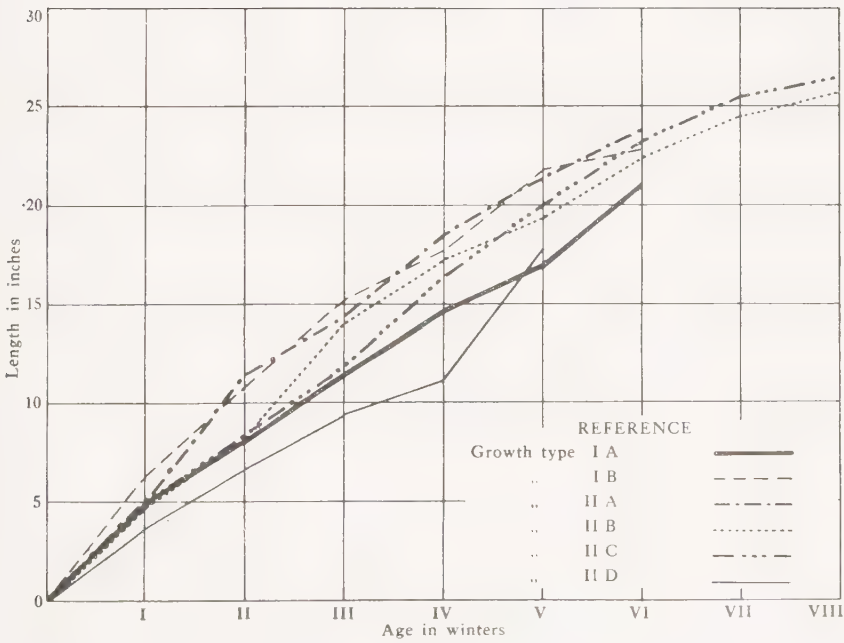


FIG. 4.

Inset—Bull. 4.

Table No. 12 (Combined Averages).

River.	Length, in Inches, attained at End of Winters.							
	1.	2.	3.	4.	5.	6.	7.	8.
Selwyn	4·8	8·7	12·5	15·9	18·7	19·9	..	..
Number Two Stream	5·5	10·2	13·9	16·9	18·6	22·4	24·8	26·3
Kaituna Stream ..	5·1	8·2	11·8	17·7	20·2	22·2	..	..
Hart's Creek ..	5·1	8·8	14·0	17·7	21·4	24·0	..	..
Ellesmere system	5·1	9·6	13·0	17·0	19·7	22·1	24·8	26·3

From Table No. 12 the average growth of the trout taken from each river may be read.

The fish taken from Hart's Creek show on an average the fastest growth. Those from the Selwyn River, on the other hand, show the slowest growth, while the fish from the Number Two and Kaituna streams are intermediate in their average growth-rates.

It will be noticed that the average growth-rates given above for each year show appreciable variation, and more especially is this evident after the yearling stage.

A more significant idea of the character of the individuals comprising the sample from the various streams is obtained by analysing the data into the classes or growth-types according to the method described on p. 10, which may here be repeated.

Type Ia. Relatively slow even growth.

Type Ib. Relatively fast even growth.

Type IIa. Slow growth during the first year of life, after which accelerated growth takes place.

Type IIb. Where accelerated growth does not take place until the end of the second or the beginning of the third year of life.

Type IIc. Where relatively slow growth has taken place during the first three years of life, after which much faster growth takes place.

Type IId. Where this accelerated growth takes place after four years of poor growth.

Table No. 13 (Percentage of each Growth-type).

River.	I.		II.			
	A.	B.	A.	B.	C.	D.
Selwyn	43·3	21·6	13·3	16·6	5·0	..
Number Two Stream ..	21·7	26·0	30·4	8·7	8·7	4·3
Kaituna Stream ..	..	..	..	..	..	100·0
Hart's Creek ..	..	28·5	14·3	28·5	14·3	14·3

It is obvious that the character of the composite growth-curve shown in the graph (Fig. 1) will depend upon the proportion of the different growth-types represented in the sample.

The questions of vital importance when dealing with the growth of brown trout are, What is the cause of this change to accelerated growth? Why does it occur at a certain age in some individuals while not in others from the same stream? If growth is accelerated by the fish migrating to a locality where food is more abundant, we may accordingly make the following supposition with regard to the fish under consideration. That the fish included in all the types in Table No. 13, with the exception of type Ia, have migrated to a more favourable environment either at the beginning of their first summer as fingerlings (Ib), at the end of their first or beginning of their second summer as yearlings (IIa), at the end of their second or beginning of their third summer as two-year-olds (IIb), or as three-year-olds (IIc) or four-year-olds (IId)

Now, though this has not been proved, it seems extremely likely that, firstly, this favourable environment is Lake Ellesmere, and, secondly, that there are regular migrations down the streams to the lake at least once a year. If this assumption is correct, the interpretation of Table No. 13 is obvious. Without this assumption, this variability in growth would be difficult to explain.

Bearing in mind what has been said above, we may summarize the data as follows:—

In the Selwyn River roughly 43 per cent. of the fish do not go down to the lake at all. These individuals, if the assumption is correct, are typical river fish. Their growth-rate is shown in Table No. 14. The others, roughly 57 per cent. of the sample, migrated down to the lake at some time during their life, and returned to the river after a varying period of lake life. The second group may be further divided into various groups (Ib, IIa, IIb, and IIc) according to the age at which they migrated, either after a few months or after one, two, three, or four years of life. By consulting Table No. 13 again, we find that of the total sample 21 per cent. migrated as fingerlings, 13 per cent. as one-year-olds, 16 per cent. as two-year-olds, and 5 per cent. migrated as three-year-olds, and so on.

In the case of the Number Two Stream we find a smaller percentage that had not migrated at all than that which occurred in the Selwyn River—namely, 21 per cent. as opposed to 43 per cent. Then 26 per cent. migrated as fingerlings, 30·4 per cent. as yearlings, 8·7 per cent. as two-year-olds, 8·7 per cent. as three-year-olds, and 4·3 per cent. at four years of age.

Only two examples were obtained from the Kaituna Stream, and these have both migrated at four years of age.

In Hart's Creek none were found that showed continuous river growth. In the sample from this river, 28·5 per cent. migrated as fingerlings, 14·3 per cent. as yearlings, 28·5 per cent. as two-year-olds, 14·3 per cent. as three-year-olds, and 14·3 per cent. as four-year-olds.

The above analysis is represented graphically in fig. 3. At regular intervals along the abscissæ are the different growth-types (Ia, Ib, &c.), and on the ordinates we have the percentage of individuals occurring in each type for each river.

It is seen from this graph that when we exclude the Selwyn River data a fairly low percentage is found showing continuous river life (Ia), especially in Hart's Creek where all had migrated.

Unfortunately, the present material is too scanty to enable definite conclusions to be drawn, but one is led to suppose that no spawning takes place in Hart's Creek, and that its stock of brown trout is kept up by fish which have migrated up from the lake.

The most probable sources of errors to which the above classification of group-types is subject, and which might give a picture other than that which actually occurs, are as follows :—

(1) That the Ib type may include fish which have never migrated, and that this relatively fast rate of growth may be due to some inherent character of the individual.

(2) That Ia type could and will contain individuals that have not yet migrated but would have done so at some later period of life had they not been caught. This error could easily be eliminated by classifying fish of five years of age or over. As calculated for the Selwyn River this error is approximately 8 per cent. Deducting this from the percentage given in Table No. 13, we have a maximum of about 35·3 per cent. which would have stayed in the river had they lived to attain the age of five years.

The present analysis is an attempt to construct a frame-work on which future data may be arranged. It is made with the intention of enlarging and carrying out further analyses as material is accumulated to throw light especially on the following points :—

(1) Do migrations take place ?

(2) If migrations are found to take place, what types of migrations occur, and what are the causes of such types ?

(3) Assuming such migrations take place, what is their effect on growth and general appearance ?

(4) If no definite migrations are shown to take place, what is the cause or causes of the accelerated growth occurring at irregular intervals during the life of the fish ?

It should be noted that the above problems are general, and, of course, apply to every river or lake in which trout have become acclimatized. On the other hand, we have numerous specific problems, for the most part connected with individual rivers and lakes.

The presentation of the data collected is therefore intended to elucidate by further analysis, if necessary, the two types of problems. Firstly, those connected with the general and fundamental principles of the growth of the trout, the solution of which is essential before specific analysis and interpretations can be made ; and, secondly, those problems which deal with populations of trout living under specified and local conditions.

In the following table are given the average rates of growth of the fish classified according to the time at which acceleration in growth began, or, by hypothesis, at which migration took place.

Table No. 14.

Growth-type.	Length, in Inches, attained at End of Winters.							
	1.	2.	3.	4.	5.	6.	7.	8.
Selwyn River, Season 1927–28.								
Ia	5·03	8·3	11·6	14·0	17·0	..	..	..
Ib	5·5	10·0	..	..	..	..	..	..
IIa	4·6	10·6	13·9	16·4	..	..	..	..
IIb	4·3	7·2	12·4	17·6	18·7	20·2	..	..
Selwyn River, Season 1928–29.								
Ia	4·5	7·7	9·6	14·3	17·2	20·1	.	..
Ib	5·5	11·2	15·7	17·6	21·7	.	..	..
IIa	4·5	10·2	11·5	..	..	..	..	..
IIb	4·3	7·5	12·1	16·3	20·0	..	..	..
IIc	3·7	7·0	10·5	16·6	..	..	..	..

TABLE NO. 14—*continued.*

Growth-type.	Length, in Inches, attained at End of Winters.							
	1.	2.	3.	4	5.	6.	7.	8.
Selwyn River, Season 1929–30.								
IA	4·2	7·6	11·2	15·3	..	..	..	..
IB	6·5	10·0	12·5	..	..	..	..	..
IIA	3·8	10·3	14·6	17·6	20·2	..	..	..
IIB	4·8	8·9	14·7	17·0	..	..	..	..
IIC	4·7	7·7	11·2	16·2	19·0	..	..	..
Number Two Stream, Season 1927–28.								
IA	6·3	9·3	13·7	15·2	17·2	..	..	..
IB	7·0	13·0	..	..	..	..	..	..
IIA	5·5	13·0	16·0	18·7	..	..	..	..
IIB	6·0	9·5	16·0	18·0	..	..	..	..
Number Two Stream, Season 1928–29.								
IA	4·3	7·5	10·9	14·4	16·6	21·0	..	..
IIA	6·2	12·5	15·1	17·3	20·8	23·0	..	..
IIC	4·2	7·2	10·0	15·2	20·0	22·5	25·0	26·5
Number Two Stream, Season 1929–30.								
IB	6·6	11·7	16·0	17·5	20·6	22·7	..	..
IIA	6·0	11·5	15·3	20·0	21·7	24·5	26·2	..
IIB	5·5	9·0	15·2	18·0	20·0	23·0	24·5	25·7
IIC	6·5	10·0	12·2	18·5	20·2	..	..	..
IID	4·2	6·5	9·7	11·5	18·7	..	..	..
Kaituna Stream, Season 1927–28.								
IIC	5·1	8·2	11·8	17·7	20·2	22·2	..	..
Hart's Creek, Season 1929–30.								
IB	7·0	10·0	14·7	18·2	23·5	..	..	..
IIA	4·7	11·7	17·7	21·2	23·5	..	..	..
IIB	4·6	7·0	13·5	17·1	21·2	24·0	..	..
IIC	5·2	9·0	14·7	20·5	22·2	24·0	..	..
IID	3·2	7·0	9·2	11·7	16·7	..	..	..

A discussion of the relative importance of the effect that the time of migration has on subsequent growth, and consequently the mean length at any year of life, is held over until further material has been obtained.

YEAR CLASSES.

In the following analysis the rivers will be dealt with separately and a comparison will be made in the summary at the end of this section :—

Selwyn River, 1927–28.

In the material collected during this season the following year classes are represented : 1921, 1922, 1923, 1924, 1925, and 1926. These year classes are now dealt with in the above order.

1921 Year Class.—The members of this year class, as six-year-olds formed 5·8 per cent. of the sample for the season 1927–28. When caught they averaged 21¼ in. in length, and 4 lb. 2 oz. in weight. Their average condition factor is therefore about 13. This year class has probably passed its zenith, and forms only a very small percentage of the population of brown trout in this river during the season under discussion.

1922 Year Class.—When they were caught the members of this year class averaged 18 in. in length, and 2 lb. 8 oz. in weight, and had an average condition factor of about 43½.

1923 Year Class.—These (four-year-olds) comprised 41·17 per cent. of the sample. They averaged 17·6 in. and 2 lb. 4 oz. when caught; mean condition factor, about 42½. This is the predominant year class and is probably at its zenith during this season.

1924 Year Class.—These (three-year-olds) form 23·5 per cent. of the sample. Their average length was 14¾ in. and weight 4 lb. 12 oz.; condition factor, about 44. This year class will probably be the predominant one in next season's (1928–29) material.

1925 Year Class.—The members of this year class averaged 14¼ in. in length and 1 lb. 3 oz. in weight. These two-year-olds formed 11·7 per cent. of the sample. Their average condition factor was 42.

1926 Year Class.—The fish comprising this year class had completed only one winter, being caught therefore in their second summer. Their average length and weight were 10 in. and 10 oz. respectively. This year class will in all probability be the predominant one in the catches during the season 1930–31.

Selwyn River, 1928–29.

Five year classes are represented in the 1928–29 material—*i.e.*, 1922, 1923, 1924, 1925, and 1926.

1922 Year Class.—In the 1927–28 sample this year class was represented as five-year-olds. They form 5·8 per cent. of the sample for the present season (1928–29), and they have now become six-year-olds averaging 20·4 in. in length and 2 lb. 8 oz. in weight. Their average condition factor was about 30.

1923 Year Class.—These five-year-olds form 20 per cent. of the total sample for the present season. Their average length was 20·8 in. and average weight 5 lb. 3 oz. This is an average gain of 3·2 in. in length and 2 lb. 15 oz. in weight from last season (1927–28). This year class is past its zenith, and will probably diminish in number in the catches of 1929–30 and 1930–31 seasons.

1924 Year Class.—The members of this year class are now four years old, and constitute the predominant class in the catches during the season under discussion, forming 35 per cent. of the total sample. They averaged 18·3 in. in length and 3 lb. 4 oz. in weight. This gives these fish an average gain of 3·6 in. in length from last season, when they averaged 14·7 in.

1925 Year Class.—The fish of this year class (three-year-olds) now average 16·3 in. in length and 2 lb. 9 oz. in weight, giving a mean condition factor of 55. They have gained since last season (1927–28) 2·1 in. in length and 1 lb. 6 oz., in weight and consequently show a very great improvement in condition.

1926 Year Class.—The members of this year class (two-year-olds), which represent 15 per cent. of the material collected during this season, have on an average gained about 4 in. in length and 1 lb. in weight since last season (1927–28), giving them an average length of 14 in. and an average weight of 1 lb. 10 oz.

Selwyn River, 1929–30.

In the samples collected during the season 1929–30 the following year classes are represented, 1924, 1925, 1926, 1927, and 1928:—

1924 Year Class.—This five-year-old class formed 9 per cent. of the sample. They averaged 20·7 in. in length and 4 lb. 5 oz. in weight. These fish have gained about 2·4 in. and 1 lb. 1 oz. since last season (1928–29), and about 6 in. since the season of 1927–28.

1925 Year Class.—The fish of this year class (four-year-olds) now average 17·7 in. in length and 2 lb. 15 oz. The increase in length may be read from Table No. 15 where further details for each year class are given. This is the predominant year class during the season 1929-30, being represented by 39·2 per cent.

1926 Year Class constitutes 9 per cent. of the sample. These three-year-old fish when caught averaged 18·6 in. and 3 lb. 4 oz., with a mean condition factor of about 60. This signifies an increase of 1·6 in. and 1 lb. 10 oz. in length and weight respectively over last season.

1927 Year Class.—These two-year-olds formed 21·7 per cent. of the sample. Their average length and weight was 11 in. and 14 oz. respectively.

1928 Year Class.—This year class (one-year-old) forms 21·7 per cent. of the sample. The members of this class averaged 9·7 in. in length and 6 oz. in weight, with an average condition factor of 42.

From what has been said above, under the separate year classes, the following very important points will have been observed :—

Firstly, that the predominant age is four years, and secondly, that we will have to look to the year classes 1926, 1927, and 1928 for any signs of depreciation in the stock for the seasons 1930–31 and 1931–32, and also by further analysis of these year classes we may be able to look a little way into the future.

Number Two Stream, 1927–28.

Only five fish were obtained during this season for age determination. The following year classes were represented with the number of specimens included in each class : 1922 (one specimen), 1923 (three), and 1924 (one). No further remarks for this season will be necessary. The average length and growth may be read from Table No. 18.

Number Two Stream, 1928–29.

Only six specimens were available. The following are the year classes represented : 1920 (represented by one specimen), 1922 (by two specimens), and 1923 (by three specimens). For further particulars the reader is referred to Table No. 18.

Number Two Stream, 1929–30.

In the material collected during this season, the following year classes are represented : 1921, 1923, 1924, 1925, and 1926. There is insufficient material available for a full analysis, but the following results may be noted :—

1921 Year Class.—This class is represented in the material by two examples averaging 26·7 in. in length and 9 lb. 2 oz. in weight.

1923 Year Class (six-year-olds).—Averaged 23 in. in length and weighed 6 lb.

1924 Year Class (five-year-olds).—Averaged 21 in. in length and 5 lb. in weight. This is the predominant year class of the sample.

1925 Year Class (four-year-olds).—Averaged 22·6 in. in length and 6 lb. in weight. These fish show excellent growth, and the great fluctuations occurring in the year classes is due to the inadequacy of the material available. It is hoped that for the season 1930–31 a fairly large and representative collection of material will be available for this river.

1926 Year Class (three-year-olds).—Averaged when caught 17·6 in. in length and 3 lb. 6 oz. in weight. The mean growth of the fish of each year class and further particulars are given in Table No. 18.

Hart's Creek 1929–30.

Of the seven fish obtained from this stream the following year classes are represented: 1923 (3), 1924 (2), and 1925 (2). Further particulars are seen in Table No. 15.

TABLE NO. 15.—HART'S CREEK.

Year Class.	Percentage of Total Sample.	Length, in Inches, attained at end of Winters.					
		1.	2.	3.	4.	5.	6.
1923 ..	28·5	4·6	7·6	13·6	18·3	21·7	24·0
1924 ..	42·8	5·5	10·5	14·6	18·0	21·2	..
1925 ..	28·5	4·2	7·7	13·5	16·7	..	..

COMPARATIVE RESULTS.

To facilitate comparisons between the different year classes occurring in each river and the same year class from different rivers the following tables are given:—

TABLE NO. 16 (SELWYN RIVER).

Season.	Average Length, in Inches, of Fish in the various Year Classes.							
	1928.	1927.	1926.	1925.	1924.	1923.	1922.	1921.
1927–28 ..	..	..	10·0	14·2	14·7	17·6	18·0	21·2
1928–29 ..	..	..	14·0	16·3	18·3	20·8	20·4	..
1929–30 ..	9·7	11·0	18·6	17·7	20·7	..	..	..

TABLE NO. 17 (SELWYN RIVER).

Season.	Average Percentage of Different Year Class.							
	1928.	1927.	1926.	1925.	1924.	1923.	1922.	1921.
1927–28 ..	..	..	11·7	11·7	23·5	41·1	5·8	5·8
1928–29 ..	..	..	15·0	15·0	35·0	20·0	15·0	..
1929–30 ..	21·7	21·7	9·0	39·1	9·0	..	..	..

TABLE NO. 18.—AVERAGE GROWTH-RATE OF FISH OF THE DIFFERENT YEAR CLASSES.

	Average Length, in Inches, attained at the End of Winters.							
	1.	2.	3.	4.	5.	6.	7.	8.
Number Two Stream (All Seasons).								
1920 ..	4·2	7·2	10·0	15·2	20·0	22·2	26·0	26·5
1921 ..	6·0	9·5	13·8	16·5	20·0	22·3	24·5	26·5
1922 ..	6·0	9·3	12·6	15·3	18·0	22·0	26·5	..
1923 ..	6·1	11·0	14·8	27·5	20·0	22·7	..	..
1924 ..	5·3	9·5	12·8	15·9	18·9	..	..	..
1925 ..	6·4	12·5	16·3	21·6	..	..	..	..
1926 ..	7·2	12·0	16·5	..	..	..	..	..
Selwyn River (All Seasons).								
1921 ..	5·0	8·0	13·0	16·7	18·7	20·2	..	..
1922 ..	5·2	9·2	12·0	14·9	17·2	19·8	..	..
1923 ..	4·6	8·4	12·0	15·6	19·3	..	..	..
1924 ..	4·8	9·0	12·7	16·8	19·6	..	..	..
1925 ..	4·4	9·0	12·8	16·1	..	..	..	..
1926 ..	5·6	9·8	15·3	..	..	..	..	..
1927 ..	4·0	7·5	..	..	..	..	..	..
1928 ..	6·2	..	..	..	..	..	..	..

In Table No. 16 is given the average length of the fish (when caught for each of the year classes) for each season.

Sexes.

In regard to the sexes the following tables (Nos. 19 and 20) give full particulars :—

Table No. 19.

River.	Season.	Sex.	Percentage.	Average Length.	Average Weight.
				In.	lb. oz.
Selwyn River ..	1927–28	♂	60	16	1 14
		♀	40	17·4	2 4
	1928–29	♂	38	19	3 8
		♀	62	17·4	3 3
	1929–30	♂	47	13·6	1 11
		♀	53	16·0	2 12
Number Two Stream	1927–28	♂	60	19·1	4 1
		♀	40	16·6	2 13
	1928–29	♂	50	22·6	4 13
		♀	50	21·5	7 6
	1929–30	♂	38·8	21·3	5 1
		♀	69·2	21·5	5 12
Kaituna Stream ..	1927–28	♂	100·0	22·3	5 2
		♀	..	..	..
Hart's Creek ..	1929–30	♂	28·6	24·5	6 8
		♀	71·4	21·7	4 11

Table No. 20.—Average Growth-rates of the Males and Females.

River.	Season.	Sex.	Length, in Inches, attained at End of Winters.							
			1.	2.	3.	4.	5.	6.	7.	8.
Selwyn River ..	1927–28	♂	5·0	9·0	12·6	16·1	18·7	20·2	..	..
		♀	4·7	9·1	12·8	15·8	17·0	..	..	..
	1928–29	♂	4·4	8·0	12·0	15·7	19·5	19·2	..	..
		♀	4·8	9·8	13·0	16·2	17·8	20·0	..	..
	1929–30	♂	4·5	8·0	11·0	15·8	19·0	..	..	..
		♀	5·1	9·0	15·2	17·4	20·8	..	..	..
Number Two Stream	1927–28	♂	6·0	10·6	15·0	17·2	17·2	..	..	..
		♀	6·5	11·1	14·4	17·5	..	..	..	..
	1928–29	♂	5·6	10·6	13·3	16·2	19·4	22·0	..	..
		♀	4·6	7·6	11·0	14·7	17·7	22·5	25·0	26·5
	1929–30	♂	6·0	11·3	16·1	20·1	21·2	..	..	..
		♀	6·2	10·4	13·8	17·3	19·7	22·7	24·5	26·0
Kaituna Stream ..	1927–28	♂	5·1	8·2	11·8	17·7	20·2	22·2	..	..
		♀	..	..	..	..	..	..	..	..
Hart's Creek ..	1929–30	♂	6·6	12·0	17·3	21·1	23·5	..	..	..
		♀	4·5	7·5	12·7	16·4	20·0	24·0	..	..

As will be seen from Table No. 19 the proportion between the number of males and females varied greatly in the different samples. This is in part probably due to the small number of fish included in each sample. Generally speaking, the females were in better condition than the males.

Table No. 20 shows the average growth of the sexes separately for each season, and the average male and female growth-rates for the whole sample are represented graphically in fig. 5. As pointed out earlier in this paper, these average growth curves must be read with due reserve, as the slope of such curves is directly influenced by the proportion of fish of the various growth-types included in the data, and will deviate from the true mean of the population in cases where the samples consist of only a few individuals.

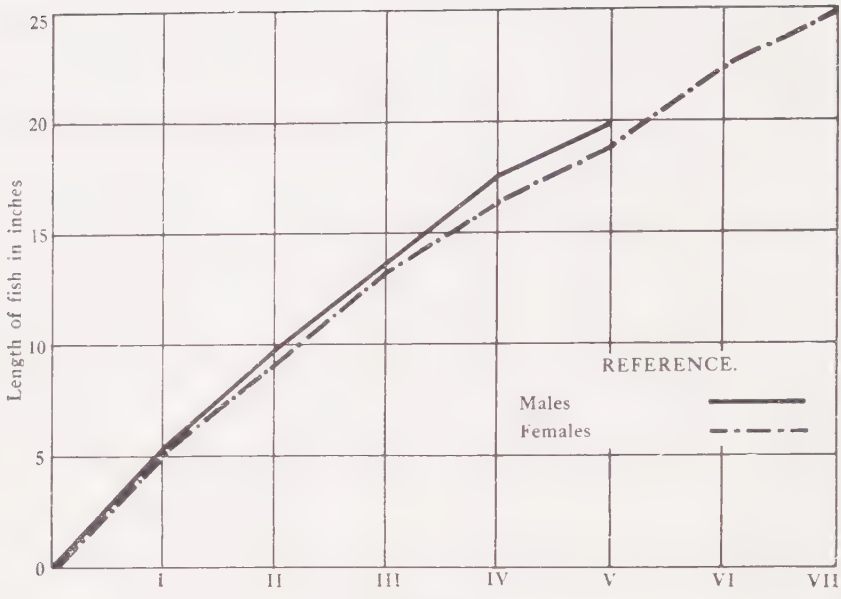


FIG. 5.

SUMMARY.

The above results may be summarized as follow:—

(1) The predominant age of the fish was four years.

(2) The fish taken from the Ellesmere system during the seasons 1927–28, 1928–29, and 1929–30 show two distinct types according to the age and growth rates.

The first type includes those fish taken from the Selwyn River, showing a fairly wide range in age with the mode at five years, and show a relatively slow average growth-rate compared with that of the second type.

The second type, comprising all those taken in the Ellesmere system exclusive of the Selwyn River: These fish either show in respect to age a fairly constricted range—*i.e.*, Hart's Creek—or a very wide range—*i.e.*, Number Two Stream—but they agree in that they have a common mode of six years. Their growth-rate is decidedly faster than that calculated from the Selwyn fish.

(3) The majority of the fish taken from the Selwyn River appeared to have not migrated—that is, they show by the examination of their scales to have grown relatively slowly and uniformly throughout life. In the case of the Number Two Stream the majority had migrated as yearlings, and only 22 per cent. showed relatively slow and uniform growth. From the Hart's Creek samples none were found to have grown slowly and uniformly throughout life, but had migrated either as fry, yearlings, two-year or three-year olds. This is shown clearly in Graph 2.

(4) In the Selwyn River the 1923 year class predominated during the 1927–28 season, the 1924 year class during the following season (1928–29), and the 1925 year class during the 1929-30 season. It should be noted here that the percentage composition of the various year classes for the other streams dealt with in this report are not given, due to the inadequacy of the available material.

IV.- BROWN TROUT FROM THE APARIMA RIVER (SOUTHLAND) TAKEN DURING SEASON 1929-30.

To give the reader some idea of the type of river from which the fish discussed in this paper were obtained, perhaps I can do no better than to quote a passage from page 33 of "Trout and Salmon Fishing in Southland," published by the Southland Anglers' Club, Invercargill, 1929:—

"The Aparima, one of the principal Southland rivers, rises in the Takatimas, flows in a southerly direction, and after covering a distance of some ninety miles enters the Aparima or Jacob's River Estuary at Riverton. It is a clear, rain-fed, even-flowing river, and can be fished over practically its entire length. There are good roads on either side of the stream, and comparatively little bush to impede the movements of the angler. At certain places the Aparima can be waded at any period of the season. North of Wrey's Bush the river is bouldery in places, but south of the township the bed is of shingle and gravel, with the result that many fine beaches are in evidence. From Thornbury upwards the Aparima can be fished with either wet or dry fly, the best results being obtained in the summer and autumn months. When the water is low and clear a fly of small size is most effective. In its lower reaches the river is subject to tidal influences, and from Thornbury to Riverton, and even in the estuary itself, the bait fisherman obtains enviable catches."

Material.

The thirty-one sets of scales upon which this chapter is based, were obtained from Thornbury, Gropers, Wrey's Bush, and Fairfax. They were all taken during the months of March and April.

Age.

In all cases the age is calculated up to the end of the last winter (1929) through which the fish had lived. In Table A, in the appendix, full particulars are given of each fish with the calculated length at the end of each winter.

The average age of the sample is 3·12 years. The females were on an average younger than the males, their mean ages being 2·87 and 3·93 respectively. Unfortunately in a number of cases the sexes had not been determined.

In the following tables further particulars are given:—

Table No. 21.

	Average Age.	Average Length.	Average Weight.
	Years.	In.	lb. oz.
Total sample ..	3·12	16·92	2 3
Males	3·93	18·38	2 10
Females ..	2·87	15·47	1 13

The females comprised 39·13 per cent. of the fish whose sexes had been determined.

Rate of Growth.

The rate of growth varies a good deal. The empirically found average sizes of the trout calculated from Table D in the appendix are as follow :—

Winters	1.	2.	3.	4.	5.	6.	7.
Length of fish, in inches ..	5·16	10·60	13·73	16·75	17·91	19·83	20·00

The mean annual increments are therefore—

Year	1st.	2nd.	3rd.	4th.	5th.	6th.	7th.
Increment, in inches ..	5·16	5·44	3·13	3·02	1·16	1·92	0·17

These average growth rates are shown graphically in Fig. 1, which also illustrates the average rates of growth of the trout comprising the Sumner, Ellesmere, and Hutt River samples.

It will be noticed that on an average the second year's growth is slightly greater than that which takes place during the first year. This is due, as will be seen further on in this paper, to the high percentage of fish that show a particular type of growth—namely, the IIa type.

In the following table (No. 22) is given the number of fish which may be assigned to the various types defined on p. 10 :—

Table No. 22.

Growth-types.	Ia.	Ib.	IIa.	IIb.	IIc.
Number of fish ..	4	9	16	2	..
Percentage ..	12·80	29·21	51·51	6·45	..

From the above table it will be seen that roughly half of the fish examined belong to the IIa type, while a little more than one-third belong to type Ib. These are the predominant types occurring in the present sample.

It is interesting to note whether there is any correlation between these types of growth and the distance from the mouth of the river at which the fish were taken. It must be understood that the number of fish that are available from each locality is inadequate, and these figures only serve to indicate certain probabilities, which cannot, unfortunately, be investigated until more material is available. However, the following analysis, although the figures do not indicate any close connection, may be useful when dealing with future material from this river.

Table No. 23.

	Miles from Mouth.	Growth-types.				
		Ia.	Ib.	IIa.	IIb.	IIc.
		Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Wrey's Bush ..	33	..	..	100	..	..
Fairfax	13	..	50	50	..	..
Thornbury ..	7	17·39	26·08	47·82	8·69	..

In the following table measures of the variability in the size of the fish at different ages are given :—

TABLE No. 24.

Winters	1.	2.	3.	4.	5.	6.	7
Mean length, in inches ..	5·16	10·60	13·73	16·75	17·91	19·83	20·00
Standard deviation ..	0·10	1·77	1·61	1·36	1·89	.	.
Coefficient of variability ..	1·93	16·69	11·71	8·41	10·55	.	..

It will be seen that the greatest variability in length occurs among fish at two years old. This accounts for the relatively high variability that occurs in older fish. The low variability in length at the end of their first winter suggests that they have all grown under relatively uniform conditions.

YEAR CLASSES.

The sample contains representatives of six year classes—1922, 1923, 1925, 1926, 1927, and 1928. We will consider each year class separately as follows :—

1922 Year Class.—This year class only includes one fish which had lived through seven winters, being caught at the end of its eighth summer. Average length, 21 in.; average weight, 4 lb.; and average condition factor, 44.

1923 Year Class.—These fish had passed through six winters, and were therefore caught during their seventh summer. They comprised 6·4 per cent. of the fish examined. They averaged in length when caught 21·7 in. and in weight 4 lb. 4 oz., and had an average condition factor of 42.

1924 Year Class.—There are no representatives of this year class in the sample. Further samples will show whether their complete absence is due to sampling or whether they are very scarce in the population of fish from this river due to natural causes.

1925 Year Class.—This is the predominant year class, containing 35·4 per cent. of the sample. When caught they averaged 18·3 in. in length and weighed 2 lb. 8 oz. Their average condition factor was 40·5. These fish had passed through four winters.

1926 Year Class.—Fishes of this year class had passed through three winters and comprised 16·1 per cent. of the sample. When caught during their third summer they averaged 15·5 in. in length and 1 lb. 9 oz. in weight. Their average condition factor was 41·4.

1927 Year Class.—This year class comprised 22·6 per cent. of the total sample. They had completed two winters. When caught during their third summer they averaged 15·17 in. in length and 1 lb. 6 oz. in weight. Their average condition factor was 40·7.

1928 Year Class.—This is the latest year class represented, and is composed of young fish showing one winter band on their scales. They were caught at the end of March and April of their second summer, and averaged 11·15 in. in length, 11 oz. in weight, and had a condition factor of 50·2. Their condition was excellent. They comprised [illegible] per cent. of the fish examined.

Although the present figures are too inadequate for the formation of definite conclusions, certain significant features are suggested. The above analyses may be summarized as follows:—

(1) The 1925 year class predominates.

(2) The 1928 and 1927 year classes are well represented in the available material.

Concluding from the above, we may say that during next season (1930–31) the predominant year class will be the 1926, and that the year classes 1927 and 1928 will also be well represented.

The following table gives the average rate of growth for the fish included in the various year classes mentioned above.

TABLE No. 25.

Year Class.	Average Length, in Inches, attained at End of Winters.						
	1.	2.	3.	4.	5.	6.	7.
1928	5·45	..	..	..	..	..	..
1927	5·53	11·71	..	..	..	..	..
1926	4·70	9·25	13·10	..	..	..	..
1925	4·79	10·59	14·15	16·75	..	..	..
1923	6·00	12·00	15·37	18·00	19·20	20·75	..
1922	4·25	7·00	10·75	14·00	15·25	18·00	20·00

The growth for any year of life differs only slightly in the different year classes, although the 1923 year class is rather high throughout.

CONDITION.

Anglers were asked to send in particulars, and specimens where possible, of "slabs" as the condition and growth of those fish appears to be extremely interesting. In the present material there is one particular fish which according to Corbett's scale has a condition factor of $27\frac{1}{2}$. It weighed 12 oz. and had a length of 14 in. If the above dimensions are correct this fish was certainly a slab, though no note to this effect was attached to the particulars given with scale samples.

I might take this opportunity to point out to anglers that accurate weights and measurements are essential for scientific purposes. The length of trout should be taken on the flat, not round the curve of the body—from the tip of the snout to the end of the centre rays of the tail. The girth should be taken with a tape-measure just touching the front edge of the dorsal fin. The fish should be weighed as soon as possible after it is caught.

The fish varied greatly in condition, though the average was fairly high, the condition factor being 42·4. The lowest factor recorded is $27\frac{1}{2}$ and the highest is 55.

For comparison the following figures are given:—

	Mean C.F.
Selwyn River	45·5
Main Drain	41·25
Mataura River	45
Rakaia River	45
Lake Sumner	33·7
Lake Shepperd	34·5
Lake Raupo	32·3

Summary.

The foregoing chapter may be summarized as follows:—

(1) The mean age of the sample was 3·12 years.

(2) The males on an average were one year older than the females.

(3) The predominant type of growth was that in which the fish had migrated to more favourable conditions at the end of their first year of life—namely the IIa type.

(4) All the fish examined from Wrey's Bush, which is thirty-three miles from the mouth of the Aparima, showed that migration took place at the end of their first year.

(5) Fish taken nearer the mouth showed more varied types of growth.

(6) Two-year-old fish appeared to vary more greatly in size than did fish at other ages.

(7) The 1925 year class was the predominant one in the sample.

(8) In the material examined the 1927 and 1928 year classes were well represented.

(9) On an average the 1923 year class showed the fastest rate of growth.

(10) The average condition of the fish was good, but the C.F. varied greatly, the lowest being $27\frac{1}{2}$ and the highest 55.

V.—BROWN TROUT FROM THE HUTT RIVER (WELLINGTON) TAKEN DURING SEASONS 1927–28, 1928 29, AND 1929 30.

The Hutt River runs into Wellington Harbour on the southern coast of the North Island. The course is about thirty miles, and is tidal for two miles. In the lower reaches the bed is composed of shingle, but beyond twenty miles from the mouth rock and shingle with rough gorges are encountered.

This river is very heavily fished; although fish are plentiful, their average size is small. For this reason the river is of special interest.

This chapter is based upon a collection of scales collected from fish during the last three seasons 1927–28 to 1929–30, which are fairly representative of the various types occurring in the river.

Of the total number of fish, twenty-five were taken during 1927–28, thirty-two during 1928–29, and forty-two during 1929–30.

For the 1927–28 and 1928–29 collections I am indebted to Mr. A. E. Hefford (Chief Inspector of Fisheries) of the Marine Department, Wellington. The material for 1929–30 was collected by various anglers for the New Zealand Freshwater Research Committee. In the 1927–28 collection, unfortunately, in only fifteen cases was the sex determined.

The following table gives particulars of the different collections :—

TABLE No. 26.

Season.	Number.	Average Length.	Average Weight.	Sex.		Average Age.
		In.	lb. oz.	M.	F.	Years.
1927–28..	25	15·45	1 7	10	5	3·32
1928–29..	32	14·84	1 3	18	14	3·28
1929–30..	42	15·05	1 3	21	21	3·35
1927–28 to 1929–30 ..	99	15·11	1 4	49	40	3·31

It will be noticed that during 1927–28 fish were slightly larger both in weight and length than those collected during last season (1929–30).

AGE.

In all calculations the age is estimated up to the end of the last winter through which the fish had lived. Therefore the fraction of a year from the end of the last winter up to the time of capture is not taken into consideration.

The particulars for each fish at the time of capture, together with its calculated length at the end of each winter, are given in Tables F, G, and H in the appendix.

The following table (No. 27) shows the mean age, weight, and length for this river together with data obtained from some of the Canterbury lakes and the Aparima River which have already been discussed.

TABLE No. 27.

River, &c.	Season.	Average Age.	Average Length.	Average Weight.
		Years.	In.	lb. oz.
Hutt River	1927–28	3·3	15·4	1 7
Hutt River	1928–29	3·3	14·8	1 3
Hutt River	1929–30	3·3	15·0	1 3
Aparima River	1929–30	3·2	16·3	2 0
Lake Sumner	1929–30	4·7	17·9	2 4
Lake Raupo	1929–30	6·6	24·6	4 12
Lake Shepperd	1929–30	5·8	23·3	3 10
Loch Katrine	1929–30	6·4	22·6	3 12
Selwyn River	1929–30	2·9	14·8	2 1

The following table gives further particulars in regard to the age composition of the samples :—

TABLE No. 28.

Season.	Age in Winters.									
	2.		3.		4.		5.		6.	
	Number	Per-centage.	Number	Per-centage.	Number	Per-centage.	Number	Per-centage.	Number	Per-centage.
1927–28 ..	1	4	17	68	5	20	2	8	..	..
1928–29 ..	6	18	16	48	6	18	3	9	1	3
1929–30 ..	4	9	23	54	11	26	4	9	..	..
Total ..	11	11·1	56	56·5	22	22·1	9	9·1	1	1

Rate of Growth.

The mean rate of growth for the fish taken during the last three seasons is given in Table No. 29.

Table No. 29.

Season.	Age in Winters.					
	1.	2.	3.	4.	5.	6
	In.	In.	In.	In.	In.	In.
1927–28 ..	4·5	9·12	12·47	14·71	16·26	..
1928–29 ..	5·14	9·64	13·44	15·05	17·10	20·00
1929–30 ..	4·73	8·34	11·65	14·08	16·12	..

Generally speaking, the samples for the seasons 1927–28 and 1928–29 show very similar growth with no significant departures, except possibly during the first year of life.

There is, on the other hand, exhibited in the fish taken last season a decided slackening-off in the rate of growth, and without exception the length attained at the end of each winter is decidedly smaller than that attained by the 1927–28 and 1928–29 fish for the corresponding age. Further analysis is required before the significance of this variation in character can be elucidated.

Classification into growth-types gives the following results:—

Table No. 30.

Season.	Growth-type.							
	Ia.		Ib.		IIa.		IIb.	
	Number.	Percentage.	Number.	Percentage.	Number.	Percentage.	Number.	Percentage.
1927–28	7	28·0	11	44·0	2	8·0	5	20·0
1928–29	7	21·8	12	37·5	11	34·5	2	6·2
1929–30	15	35·7	15	35·7	4	9·5	8	19·0
Totals ..	29	..	38	..	17	..	15	..
Means ..	9·6	29·2	12·6	38·3	5·3	17·1	5·1	15·2

The proportions are shown graphically in fig. 6 (p. 35).

It will be seen that the type Ib is predominant. These are fish which show more or less uniform and relatively rapid growth.

It is interesting to compare these figures with those obtained from fish taken from the Aparima River, Southland. This is done in the following table (No. 31).

Table No. 31.

	Growth-types.			
	Ia.	Ib.	IIa.	IIb.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.
1929–30, Aparima River ..	12·9	29·3	51·6	6·4
1927–30, Hutt River ..	29·2	38·3	17·1	15·2

It is at once observed from the above figures that the fish taken from the Hutt River are more evenly distributed among the various types of growth. Again, in the Hutt River, type Ib is predominant while the predominant type in the Aparima River is IIa. This difference will manifest itself in the mean average length of the Aparima fish of, say, four years old.

We have seen that the Aparima fish on an average attain a length of 16·75 in. at the end of their fifth winter, while those fish of the same age from the Hutt River only average 14·7 in. This difference then may be accounted for by the difference observed in the types of growth shown above.

The mean growth-rates for each type are given in the following table (No. 32) and are graphically shown in fig. 7.

Table No. 32.

	End of Winters.					
	1	2.	3	4	5	6.
Season 1927–28.						
Growth—	In.	In.	In.	In.	In.	In.
Type Ia	4·67	7·89	11·14	13·56	15·25	..
Type Ib	5·63	10·31	12·87	17·25	..	..
Type IIa	4·62	11·87	14·50	..	..	.
Type IIb	4·50	7·50	12·75	15·75	18·50	.
Season 1928–29.						
Growth						
Type Ia	4·87	7·50	11·45	14·00	..	..
Type Ib	5·60	10·06	14·33	15·12	18·25	20·00
Type IIa	5·07	10·67	13·66	15·45	16·50	
Type IIb	4·00	7·75	12·20	13·50	..	..
Season 1929–30.						
Growth—						
Type Ia	4·36	7·51	10·87	13·25	14·75	..
Type Ib	5·01	9·00	12·07	15·55	16·50	..
Type IIa	4·93	11·06	13·50	..	..	..
Type IIb	4·59	7·09	11·78	13·62	16·75	..

From the above it will at once be apparent that those fish which have migrated either at the beginning of their first summer or those that migrated at the end of first or beginning of second summer are on an average larger, say, at the end of their fourth winter, than the fish that show other types of growth. Unfortunately, the data upon which the above figures are based are insufficient to illustrate this conclusively. It serves to show that the obvious advantage in classifying fish in this way is that we may later come to some definite knowledge upon the correlation between the time at which the fish migrates and the influence this migration has upon its ultimate length.

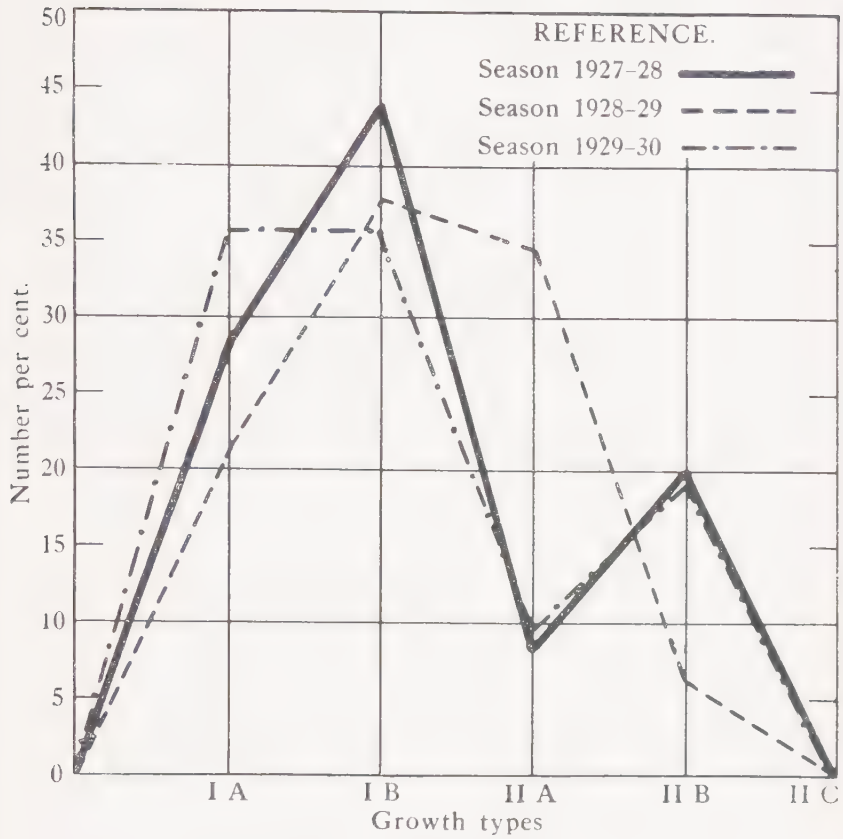


Fig. 6.—The percentages of different growth-types in the Hutt River.

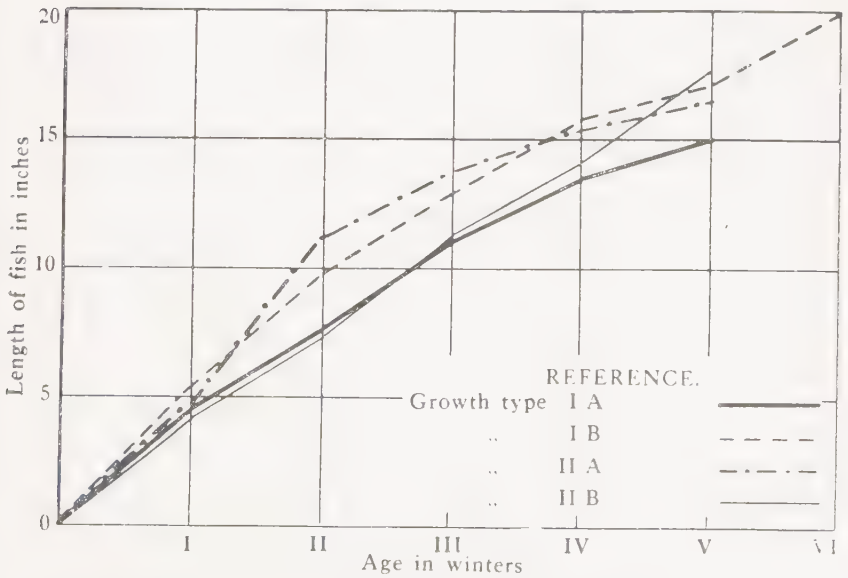


Fig. 7. The mean growth-rates for each growth-type of Hutt River trout.

Year Classes.

Season 1927–28.

The 1927–28 material consists of four distinct age-groups. The year classes concerned are the 1922, 1923, 1924, and 1925.

Year Class 1922.—These fish when caught during the season 1927–28 had completed five winters, and were in their sixth summer. Their average growth is shown in Table No. 34. They form 8 per cent. of the total number examined. When caught they averaged 18½ in. in length and 2 lb. 6 oz. in weight.

Year Class 1923.—This comprised 20 per cent. of the sample for the season 1927–28. They had completed four winters and were caught during their fifth summer. Table No. 34 shows their average growth. When caught they averaged 16·2 in. in length and 1 lb. 11 oz. in weight.

Year Class 1924.—This is the predominant year class, comprising 68 per cent. of the sample. Their average size when caught was 14·8 in. in length and 1 lb. 4 oz. in weight. These fish had completed three winters and were caught during their fourth summer.

Year Class 1925.—This year class is represented by only 4 per cent. of the total sample. These fish, which had completed only two winters, being caught during their third summer, averaged 15·5 in. in length and 1 lb. 8 oz. in weight. Their average rate of growth is seen in Table No. 34.

Season 1928–29.

The material collected during this season consisted of five age-groups. The year classes concerned are 1922, 1923, 1924, 1925, and 1926.

Year Class 1922.—This year class comprised 3·1 per cent. of the sample. These fish had completed six winters and were caught during their seventh summer. They averaged 21 in. in length and 3 lb. in weight. It will be seen from what has been said above that these fish have gained 2½ in. in length and 10 oz. since last season (1927–28). In 1927–28 they formed 8 per cent. of the material, while during this season (1928–29) they only formed 3·1 per cent. This year class was probably at its height during the season of 1925–26.

Year Class 1923.—This year class comprised 9·3 per cent. of the total number examined from this river during 1927–28 season. These fish had completed five winters and were caught during their sixth summer. Their average growth is shown in Table No. 34. They averaged 14·3 in. in length and 1 lb. 10 oz. in weight. In the material examined this year class has dropped from 20 per cent. to 9·3 per cent. since last season (1927–28).

Year Class 1924.—Members of this year class taken during the season under discussion had completed four winters. Of the total material studied they constituted 18·7 per cent. They averaged 16·2 in. in length and 1 lb. 8 oz. in weight. This year class has passed its zenith. In 1929–30 it will probably constitute a very small percentage of the population.

Year Class 1925.—For the season under discussion this is the predominant year class. These fish were taken during their fourth summer, having completed three winters. They formed 48·7 per cent. of the sample. These fish averaged 15·3 in. in length and 1 lb. 8 oz. in weight.

Year Class 1926.—This year class forms 18·7 per cent. of the number examined. It is the youngest age-group represented, having completed only two winters. Members of this year class will in all probability be predominant in next season's catch as three-year-olds. As this year class comprises 18·7 per cent. as against 4 per cent. for the 1925 year class of the previous season (1927–28) we might, if our samples were representative, expect an even greater predominance of three-year-olds during the season 1929–30 than what occurred in the season under discussion—namely, 48·7 per cent.

Season 1929–30.

The data collected during this season represents four age-groups—viz., year classes 1924, 1925, 1926, and 1927.

Year Class 1924.—The members of this year class have now completed five winters. Their average size is 17·4 in. in length and 1 lb. 11 oz. in weight. This class represents 9·5 per cent. of the material collected during this season. In Table No. 34 their mean rate of growth is shown.

Year Class 1925.—This year class is represented during this season by 26·1 per cent., against 48·7 per cent. the previous season (1928–29), when it was the predominant year class. Their average length when caught was 16·1 in., and had an average weight of 1 lb. 12 oz.

Year Class 1926.—This is the predominant year class for this season, comprising 54·7 per cent. of the sample.

By a study of the material collected during 1927–28 and 1928–29 seasons it was predicted that the percentage of three-year-olds would be greater this season than in 1928–29. A comparison will show this to be the case. The average size of this year class is 14·3 in. in length and 1 lb. 1 oz. in weight.

Year Class 1927.—If our age analysis were based on representative samples it would be reasonable to predict that this would in all probability be the predominant year class in next season's (1930–31) material. These two-year-olds are not so numerous as last season and therefore, assuming the sample is representative, the predominance of three-year-olds in 1930–31 season will not be so marked as in the present season. In the same way we might predict from the available data that there will be a corresponding increase in the number of four- and five-year olds. Thus, the fish taken during the season of 1930–31 will be characterized, if ordinary circumstances prevail, by a higher average length than that which prevailed during the last season, 1929–30. The fish included in this year class averaged 11·9 in. in length and 1 lb. 1 oz. in weight.

The average age composition for each of the three seasons 1927–28 to 1929–30 is given in the following table :—

Table No. 33.

Average per cent. of Different Year Classes

	1922	1923	1924	1925	1926	1927
			6 winters	5 winters	4 winters	3 winters	2 winters
Season 1927–28	8·0	20·0	68·0	4·0	–	–
Season 1928–29	3·1	14·3	18·7	48·7	18·7	–
Season 1929–30	–	–	9·5	26·1	54·7	9·5

There are three ways in which the above table may be read—

(1) By reading the horizontal line we obtain the percentage of each year class during the same season.

(2) By reading down a vertical column we learn how the percentage of a given year class changes from one season to the next.

(3) By reading across the diagonal rows we learn the percentage of fishes of given ages in each season's sample.

The above table is adapted from Ford(2).

The following table shows the rate of growth of the various year classes :—

TABLE No. 34.

Year Classes.	Season.	Age when caught.	Length, in Inches, attained at End of Winters.					
			1.	2.	3.	4.	5.	6.
1922 ..	1927–28	5 winters	4·00	7·50	12·87	15·00	16·87	..
	1928–29	6 winters	5·00	9·50	12·50	15·00	18·25	20·00
Mean rate of growth			4·50	8·50	12·68	15·00	17·56	20·00
1923 ..	1927–28	4 winters	4·55	7·85	11·60	14·60	..	..
	1928–29	5 winters	5·13	10·50	13·16	15·25	16·50	..
Mean rate of growth			4·84	9·17	12·38	14·92	16·50	..
1924 ..	1927–28	3 winters	5·22	9·83	12·62	..	..	..
	1928–29	4 winters	5·33	10·08	13·12	14·72	..	..
	1929–30	5 winters	4·18	8·31	11·56	14·31	16·20	..
Mean rate of growth			4·91	9·40	12·43	14·51	16·20	..
1925 ..	1927–28	2 winters	6·75	13·25	..	..	..	.
	1928–29	3 winters	5·32	9·65	13·41	..	..	.
	1929–30	4 winters	4·61	7·25	11·36	14·04	..	..
Mean rate of growth			5·56	10·05	12·38	14·04	..	..
1926 ..	1928–29	2 winters	4·70	8·79	..	..	..	..
	1929–30	3 winters	4·76	8·41	11·85	..	..	..
Mean rate of growth			4·23	8·60	11·85	..	..	..
1927 ..	1929–30	2 winters	5·5	10·7	..	..	..	.

The above table should be read in conjunction with remarks under the various year classes.

I am fully convinced that, given suitable and abundant material, predictions based upon previous results can be put forward, such as a rise or fall in the average size of the fish from a particular river for at least the following season.

When we know more about the circumstances which control the spawning of the trout in this and other rivers we will be able to foretell with much more certainty what future seasons hold with regard to the abundance and average size of their trout.

In this way we may hope to detect depletion in its very early stages, during which conservation measures may be more aptly applied.

SEXES.

In the following table is given the percentage and rates of growth for the males and females for each of the seasons :—

TABLE No. 35.

Season.	Sex.	Per-centage.	Length in Inches attained at End of Winters.				
			1.	2.	3.	4.	5
1927–28 ..	Males ..	66·6	4·85	8·76	12·45	15·15	16·87
	Females ..	33·4	5·25	8·80	11·93	13·62	18·50
1928–29 ..	Males ..	56	5·21	9·68	13·67	15·5	17·12
	Females ..	44	5·08	9·58	12·83	14·75	16·75
1929–30 ..	Males ..	50	4·61	7·79	11·34	14·52	15·87
	Females ..	50	4·80	8·59	11·79	12·93	16·37

The rate of growth of the males does not differ in any marked degree from the growth which takes place during the early life of the female. But at the end of their fourth winter the males are on an average larger. This is probably due to some physiological effect brought about by spawning, for at four years old nearly all (roughly 90 per cent.) have at least spawned once. It would appear from the above figures that in all probability the males do not grow as fast as the females after four years have been reached though the 1927–28 sample provides an exception to this rule.

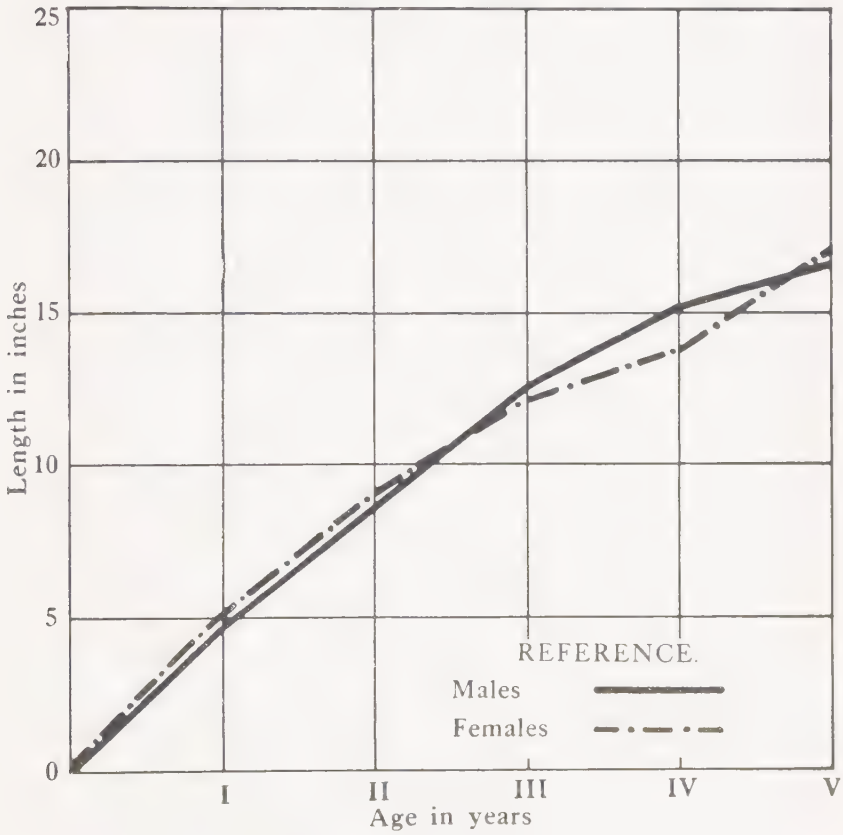


FIG. 8.—Average rate of growth of male and female trout from the Hutt River.

Summary.

We may briefly summarize the results of this investigation as follow :—

(1) The average age of the samples taken during the last three seasons, 1927–28, 1928–29, and 1929–30, was 3·31 years, with an average length of 15·11 in. and weight of 3 lb. 4 oz.

(2) The Ib type of growth was predominant. In this type are included fish which grow relatively fast and show moderately even growth throughout life.

(3) In the sample taken during the season 1927–28 the 1924 year class was predominant. The fish had completed three winters, and were caught during their fourth summer.

(4) In the 1928–29 season the 1925 year class was predominant, and in 1929–30 the 1926 year class predominated. Briefly, the three-year-olds predominated in the samples taken during the three seasons.

(5) The males and females grew at about the same rate until four years had been reached, after which the males grew somewhat more quickly than the females.

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APPENDIX.

Particulars as to Length, Weight, Condition, Sex, Age, and Growth of the Individual Fish comprising the Samples investigated.

TABLE A (LAKE SUMNER DISTRICT).

Length.	Weight.	C.F.	Sex.	Age.	Calculated Length, in Inches, at End of Winters.					
					1	2	3	4	5	6
(a) Lake Sumner.										
In.	lb. oz.									
22	3 4	31	M	6	5	12	$14\frac{3}{4}$	$19\frac{1}{2}$	$20\frac{3}{4}$	$21\frac{3}{4}$	
$7\frac{1}{2}$	.. ..	..	..	1	5	..	..	..	.	.	
$17\frac{3}{4}$	2 0	36	F	5	$4\frac{1}{2}$	$7\frac{1}{4}$	10	$14\frac{1}{4}$	17	.	
$15\frac{3}{4}$	1 8	39	M	4	$5\frac{1}{2}$	$8\frac{1}{2}$	$11\frac{1}{4}$	$14\frac{1}{2}$	..	..	
$20\frac{1}{2}$	3 8	42	M	5	$3\frac{1}{4}$	$6\frac{1}{4}$	$11\frac{3}{4}$	$16\frac{3}{4}$	$19\frac{3}{4}$	..	.
$23\frac{3}{4}$	4 8	34	M	7	$4\frac{1}{2}$	$9\frac{1}{2}$	$12\frac{1}{2}$	$17\frac{1}{2}$	$19\frac{1}{2}$	$21\frac{1}{4}$	23
$23\frac{1}{2}$	2 8	20	M	7	$3\frac{1}{2}$	$7\frac{1}{4}$	$15\frac{1}{4}$	$17\frac{3}{4}$	20	$21\frac{3}{4}$	$22\frac{3}{4}$
$13\frac{1}{2}$	0 14	35	M	3	$4\frac{1}{2}$	$7\frac{3}{4}$	$12\frac{3}{4}$	..	..	..	..
14	1 2	42	M	3	$5\frac{1}{2}$	10	$12\frac{3}{4}$	..	..	..	
21	3 6	37	M	6	5	$10\frac{3}{4}$	$14\frac{1}{4}$	17	19	$20\frac{1}{4}$	
(b) Lake Shepperd.											
$23\frac{3}{4}$	4 8	34	M	6	5	$10\frac{1}{2}$	15	$17\frac{3}{4}$	$21\frac{3}{4}$	$22\frac{3}{4}$	..
$23\frac{3}{4}$	4 8	34	M	7	$7\frac{1}{2}$	$11\frac{1}{4}$	$16\frac{1}{4}$	17	19	$22\frac{1}{2}$	23
$21\frac{1}{2}$	3 8	36	F	5	4	$8\frac{1}{2}$	$15\frac{3}{4}$	$17\frac{3}{4}$	$20\frac{1}{4}$	..	
19	2 8	37	M	5	4	$9\frac{1}{4}$	$12\frac{1}{4}$	$15\frac{1}{4}$	18	.	
$18\frac{1}{4}$	2 1	35	M	4	$5\frac{1}{2}$	$8\frac{3}{4}$	$11\frac{1}{2}$	$16\frac{1}{2}$	..	..	..
23*	4 4	35	..	7	$6\frac{1}{4}$	$11\frac{1}{4}$	14	$16\frac{1}{4}$	$19\frac{3}{4}$	$21\frac{1}{4}$	$22\frac{1}{4}$
25*	4 8	29	..	7	$5\frac{3}{4}$	$9\frac{1}{4}$	15	$17\frac{1}{4}$	20	$22\frac{1}{2}$	$24\frac{1}{2}$
(c) Lake Raupo.											
$24\frac{1}{2}$	4 12	33	M	6	4	$8\frac{1}{2}$	$11\frac{1}{4}$	$15\frac{1}{4}$	$20\frac{3}{4}$	$22\frac{3}{4}$	..
$24\frac{1}{2}$	4 8	31	M	7	$3\frac{1}{2}$	$5\frac{1}{4}$	$9\frac{3}{4}$	15	$18\frac{1}{2}$	$20\frac{1}{2}$	24
25	5 0	32	M	7	$6\frac{1}{2}$	$8\frac{1}{4}$	$14\frac{3}{4}$	18	21	23	$24\frac{3}{4}$
(d) Loch Katrine.											
23	3 8	29	M	7	$5\frac{3}{4}$	$7\frac{1}{4}$	14	$17\frac{3}{4}$	20	$21\frac{3}{4}$	$22\frac{3}{4}$
22	3 8	33	M	5	$5\frac{1}{2}$	$10\frac{1}{4}$	$15\frac{3}{4}$	19	$20\frac{1}{2}$	.	
23	4 8	37	M	7	$5\frac{1}{2}$	$7\frac{3}{4}$	12	16	$18\frac{3}{4}$	21	$22\frac{3}{4}$
$22\frac{1}{2}$	3 12	33	M	7	$5\frac{1}{2}$	$10\frac{3}{4}$	13	$16\frac{1}{4}$	$19\frac{1}{2}$	$20\frac{1}{2}$	$21\frac{3}{4}$
$22\frac{3}{4}$	3 8	30	M	6	$3\frac{1}{2}$	$6\frac{1}{2}$	$11\frac{1}{4}$	$16\frac{3}{4}$	$19\frac{1}{2}$	22	
(e) Hurunui River.											
$23\frac{1}{2}$	4 6	34	M	6	6	11	17	19	$20\frac{3}{4}$	$22\frac{1}{4}$	
$25\frac{1}{2}$	5 4	33	M	6	$5\frac{1}{2}$	9	$14\frac{1}{2}$	$19\frac{3}{4}$	20	24	
$24\frac{1}{2}$	3 0	21	M	7	6	$8\frac{3}{4}$	$13\frac{3}{4}$	$19\frac{1}{2}$	$21\frac{1}{2}$	23	22.
(f) Sister Stream.											
$5\frac{1}{2}$	.. ..	..	..	1	$4\frac{1}{2}$	.	.	.	.	.	.

* These fish were taken during January, 1928 (Season 1927–28).

TABLE B (ELLESMERE SYSTEM).

Length.	Weight.	C.F.	Sex.	Age.	Calculated Length, in Inches, at End of Winters.							
					1.	2.	3.	4.	5.	6.	7.	8.
(a) Selwyn River (1927–28).												
In.	lb. oz.											
14	1 3	39	M	2	$4\frac{1}{4}$	$8\frac{1}{2}$	..	..	..	..	..	..
$18\frac{1}{2}$	3 0	48	M	4	$6\frac{1}{2}$	11	$14\frac{1}{4}$	17	..	..	..	..
20	3 0	38	F	4	$4\frac{1}{2}$	$6\frac{1}{4}$	$12\frac{1}{2}$	$18\frac{1}{2}$	..	..	..	..
17	2 8	51	F	4	$4\frac{1}{2}$	$10\frac{1}{2}$	$13\frac{1}{2}$	16	..	..	..	..
$13\frac{1}{2}$	0 13	31	M	3	$3\frac{1}{2}$	$6\frac{1}{2}$	12	..	..	..	..	..
20	3 0	39	M	4	$5\frac{1}{2}$	11	$13\frac{3}{4}$	18	..	..	..	..
17	2 0	41	F	4	4	$10\frac{1}{2}$	$13\frac{1}{2}$	$15\frac{1}{2}$	..	..	..	..
$16\frac{1}{2}$	2 0	54	F	4	$3\frac{1}{4}$	$6\frac{1}{2}$	$10\frac{1}{2}$	14	..	..	..	..
18	2 8	43	F	5	6	$10\frac{1}{2}$	$12\frac{1}{2}$	15	17	..	..	..
15	1 8	45	M	4	$4\frac{1}{2}$	7	10	13	..	..	..	..
10	0 12	..	M	1	$6\frac{1}{2}$	..	..	..	..	..	..	..
14	1 4	47	M	2	5	10	..	..	..	..	..	..
16	1 10	43	F	3	6	$10\frac{3}{4}$	$14\frac{1}{2}$	..	..	..	..	..
$21\frac{1}{2}$	4 2	42	M	6	5	8	13	$16\frac{3}{4}$	$18\frac{3}{4}$	$20\frac{1}{4}$	..	..
17	1 9	32	M	3	5	$8\frac{3}{4}$	$12\frac{3}{4}$	..	..	..	..	..
$12\frac{1}{2}$	0 12	..		3	4	$6\frac{1}{2}$	$9\frac{1}{2}$	..	..	..	..	..
10	0 8	..	..	1	6	..	..	..	..	..	..	..
(b) Selwyn River (1928–29).												
20	4 5	..	M	6	$4\frac{1}{2}$	7	$10\frac{1}{2}$	$13\frac{1}{2}$	$16\frac{3}{4}$	$19\frac{1}{4}$	..	
19	2 8	37	M	4	$3\frac{1}{4}$	$6\frac{3}{4}$	$10\frac{1}{2}$	$17\frac{3}{4}$	..	..	..	
18	4 0	69	F	3	6	$12\frac{1}{4}$	17	..	..	..	..	
21	5 0	55	F	4	$5\frac{1}{2}$	12	17	19	..	..	..	
$19\frac{1}{2}$	3 0	41	F	4	$6\frac{1}{4}$	12	$15\frac{1}{2}$	18	..	..	..	..
17	2 0	41	M	4	$6\frac{1}{2}$	11	15	$16\frac{1}{2}$	..	..	..	..
23	5 0	41	M	5	5	$10\frac{3}{4}$	14	17	$21\frac{3}{4}$	..	..	..
13	1 0	47	F	2	$4\frac{1}{4}$	$9\frac{1}{2}$	..	..	..	..	..	..
20	3 0	38	F	6	4	$7\frac{1}{2}$	$12\frac{1}{4}$	16	$17\frac{1}{2}$	19	..	..
24	7 12	57	M	5	$4\frac{3}{4}$	$7\frac{1}{2}$	12	$16\frac{3}{4}$	$22\frac{3}{4}$	..	..	..
12	1 0	60	M	2	$3\frac{1}{2}$	$6\frac{3}{4}$	..	..	..	..	..	..
15	1 12	52	F	3	$4\frac{1}{8}$	$8\frac{3}{4}$	$11\frac{3}{4}$	..	..	..	..	..
17	3 0	62	F	2	$5\frac{1}{2}$	12	..	..	..	..	..	..
22	4 8	43	F	6	5	$9\frac{1}{2}$	12	$15\frac{1}{4}$	$18\frac{1}{4}$	21	..	..
16	2 4	56	F	4	$4\frac{1}{2}$	7	$10\frac{3}{4}$	$14\frac{1}{2}$	..	..	..	..
$18\frac{1}{2}$	4 0	64	F	5	$5\frac{1}{4}$	$7\frac{3}{4}$	$10\frac{3}{4}$	14	16	..	..	..
18	4 0	69	F	4	$5\frac{1}{4}$	9	9	$15\frac{1}{4}$	..	..	..	..
18	4 0	69	F	4	$5\frac{1}{4}$	9	9	$15\frac{1}{4}$	..	..	..	..
18	4 0	69	F	4	$4\frac{1}{4}$	$7\frac{1}{4}$	$7\frac{1}{4}$	$15\frac{1}{2}$	..	..	..	..
18	4 0	69	M	5	4	$6\frac{1}{4}$	$9\frac{1}{4}$	13	$16\frac{3}{4}$	..	..	..
(c) Selwyn River (1929–30).												
20	4 6	50	F	5	$4\frac{3}{4}$	$7\frac{3}{4}$	$11\frac{1}{4}$	$16\frac{1}{4}$	19	..	..	..
18	3 0	52	F	4	$3\frac{1}{2}$	$5\frac{1}{4}$	$10\frac{1}{4}$	$16\frac{3}{4}$	..	..	..	..
18	3 8	61	M	4	3	$7\frac{1}{2}$	$13\frac{1}{8}$	17	..	..	..	..
$11\frac{1}{2}$	0 12	..	F	2	4	$7\frac{3}{4}$	..	..	..	..	..	..
18	3 4	56	F	4	$3\frac{1}{2}$	$6\frac{1}{2}$	$10\frac{1}{2}$	15	..	..	..	..
16	2 4	56	F	4	$5\frac{1}{4}$	$7\frac{3}{4}$	12	15	..	..	..	..
$11\frac{1}{2}$	0 13	..	F	2	$4\frac{1}{2}$	$8\frac{1}{4}$	..	..	..	..	..	..
17	2 14	59	F	4	$4\frac{1}{4}$	$8\frac{1}{2}$	$11\frac{1}{2}$	16	..	..	..	..
$16\frac{1}{2}$	2 13	63	F	4	$5\frac{1}{4}$	$9\frac{1}{4}$	$11\frac{3}{4}$	14	..	..	..	..
16	2 13	69	F	3	$6\frac{1}{2}$	10	$12\frac{1}{2}$	..	..	..	..	..
$19\frac{1}{2}$	3 14	53	M	4	$3\frac{1}{4}$	$9\frac{1}{4}$	$14\frac{1}{4}$	$17\frac{1}{4}$	..	..	..	..
$21\frac{1}{2}$	4 12	48	M	3	$6\frac{1}{4}$	$10\frac{1}{2}$	$18\frac{1}{4}$	..	..	..	..	..
20	3 5	42	F	4	$4\frac{3}{4}$	$10\frac{1}{4}$	$15\frac{1}{2}$	19	..	..	..	..
11	0 9	42	M	2	$4\frac{3}{4}$	$7\frac{3}{4}$	..	..	..	..	..	..
11	0 9	42	M	2	4	8	..	..	..	..	..	..
9	0 5	..	M	1	$6\frac{1}{2}$	..	..	..	..	..	..	..
$10\frac{1}{2}$	0 8	43	M	1	$4\frac{3}{4}$	..	..	..	..	..	..	..
$21\frac{1}{2}$	4 5	41	M	5	$4\frac{1}{2}$	$11\frac{1}{2}$	15	18	$20\frac{1}{4}$	..	..	..
$16\frac{1}{2}$	2 4	51	F	4	5	9	12	$14\frac{3}{4}$	..	..	..	..
9	0 5	..	M	1	$6\frac{3}{4}$	..	..	..	..	..	..	..
10	0 6	..	M	1	7	..	..	..	..	..	..	..
10	0 7	..	M	1	6	..	..	..	..	..	..	..
10	0 7	..	F	2	$3\frac{1}{4}$	$5\frac{1}{4}$	..	..	..	..	..	..

TABLE B (ELLESMERE SYSTEM)—*continued.*

Length.	Weight.	C.F.	Sex.	Age.	Calculated Length, in Inches, at End of Winters.							
					1.	2.	3.	4.	5.	6.	7.	8.
				(d) Number Two Stream (1927-28).								
In.	lb. oz.											
19¼ ..	4 0	56	M	4	6	9½	16	18	..	..	..	..
20 ..	4 8	56	M	4	5½	13	16	18¾	..	..	..	..
18¼ ..	3 12	62	M	5	6½	9½	13¼	15	17¼	..	..	..
18¾ ..	4 0	61	F	4	6¼	9¼	14¼	17½	..	..	..	..
14½ ..	1 11	56	F	2	7	13	..	..	..	..	..	..
				(e) Number Two Stream (1928-29).								
22 ..	4 8	43	M	5	6	13¾	16	17¾	20¾	..	..	..
17 ..	3 0	62	F	5	3¾	7	10½	13¼	15	..	..	..
19½ ..	3 8	47	F	5	5¾	8¾	12½	16	18½	..	..	..
24 ..	5 0	37	M	6	6½	11¼	14¼	17	21	23	..	..
22 ..	5 0	47	M	6	4½	7	9¾	14	16½	21	..	
27½ ..	14 8	67	F	8	4¼	7¼	10	15¼	20	22¼	25	26½
				(f) Number Two Stream (1929-30).								
26 ..	9 0	52	M	4	4	10¾	16¾	25½	..	..	..	..
18 ..	2 12	47	M	3	7½	12½	17½	..	..	..	..	..
22 ..	5 0	47	M	5	6	11	15½	18	21¼	..	..	..
27 ..	9 0	46	F	8	6½	10	12½	15	20	23¾	24½	26¼
26½ ..	9 4	50	F	8	5½	9	15¼	18	20	23	24½	25¾
18½ ..	4 0	64	F	3	7	12	16¾	..	..	..	..	..
23 ..	6 0	49	F	6	6¼	11½	14¾	17	20	22¾	..	..
16¼ ..	3 0	70	F	3	7¼	11½	15½	..	..	..	..	..
19½ ..	3 8	47	M	4	6½	11¼	14½	18	..	..	..	..
21½ ..	5 10	57	F	4	7	14¼	17½	21½	..	..	..	..
22 ..	5 4	50	F	5	6½	10	12¾	18½	20¼	..	..	..
20 ..	5 0	63	F	5	5¾	9½	12½	17¼	19½	..	..	..
20¼ ..	4 12	55	F	5	4¼	6½	9¾	11½	18¾	..	..	
				(g) Hart's Creek (1929-30).								
26 ..	7 0	40	F	6	4	6¾	12½	16¼	21¼	24	..	..
20 ..	3 8	44	F	4	4¾	7¾	14½	18	..	..	..	..
25 ..	6 8	42	F	6	5¼	9	14¾	20½	22¼	24	..	
24 ..	6 8	47	M	5	8½	12¼	17	21	23½	..	..	..
18½ ..	3 0	50	F	4	5½	7¾	12½	15½	..	..	..	..
25 ..	7 0	45	M	5	4¾	11¾	17¾	21¼	23½	..	..	..
19 ..	3 8	52	F	5	3¼	7	9¼	11¾	16¾	..	..	..
				(h) Kaituna Stream (1927-28).								
23 ..	5 12	47	M	6	5	8½	11¾	17	20½	22¼	..	..
21¼ ..	4 8	44	M	5	5¼	8	12	18½	20	..	..	

TABLE C (APARIMA RIVER).

Length.	Weight.		C.F.	Sex.	Age.	Calculated Length, in Inches, at End of Winters.						
						1.	2.	3.	4.	5.	6.	7.
In.	lb.	oz.										
18	2	0	35	F	4	$4\frac{1}{2}$	11	$14\frac{3}{4}$	$16\frac{3}{4}$	..	..	..
$13\frac{1}{4}$	1	2	49	..	3	$3\frac{1}{2}$	$6\frac{3}{4}$	$11\frac{1}{2}$	..	..	..	..
$15\frac{1}{2}$	1	8	42	F	2	$6\frac{1}{2}$	$11\frac{1}{2}$	..	..	..	..	..
22	3	8	33	M	6	$5\frac{1}{2}$	$11\frac{1}{2}$	$13\frac{3}{4}$	$17\frac{1}{4}$	19	21	..
18	2	8	43	M	4	$4\frac{3}{4}$	$7\frac{3}{4}$	$13\frac{1}{4}$	$16\frac{1}{2}$	..	..	..
$17\frac{1}{2}$	2	4	42	M	4	$3\frac{3}{4}$	$10\frac{1}{2}$	$14\frac{1}{2}$	$17\frac{1}{4}$	..	..	..
$10\frac{1}{2}$	0	8	44	..	1	$4\frac{3}{4}$	..	..	..	..	..	..
16	2	0	49	F	3	$6\frac{1}{4}$	$10\frac{3}{4}$	$14\frac{1}{4}$	..	..	..	..
$15\frac{1}{4}$	1	4	35	..	3	$3\frac{1}{4}$	$6\frac{1}{2}$	12	..	..	..	..
$14\frac{1}{2}$	1	0	31	..	3	$4\frac{1}{4}$	$10\frac{1}{2}$	$12\frac{3}{4}$	..	..	..	..
$12\frac{1}{2}$	0	8	28	..	2	$5\frac{1}{4}$	$8\frac{3}{4}$	..	..	..	..	..
$21\frac{1}{2}$	5	0	51	F	6	$6\frac{1}{2}$	$12\frac{1}{2}$	17	$18\frac{3}{4}$	$19\frac{1}{2}$	$20\frac{1}{2}$	..
$17\frac{1}{2}$	2	4	42	M	4	$5\frac{1}{2}$	$11\frac{1}{2}$	14	16	..	..	..
$15\frac{1}{2}$	2	0	54	..	2	5	$11\frac{1}{2}$	..	..	..	..	..
$12\frac{1}{4}$	1	0	55	..	1	6	..	..	..	..	..	..
$12\frac{1}{2}$	1	0	52	..	1	7	..	..	..	..	..	..
21	4	0	44	M	7	$4\frac{1}{4}$	7	$10\frac{3}{4}$	14	$15\frac{1}{4}$	18	20
17	2	8	51	M	4	4	$8\frac{1}{2}$	11	$14\frac{3}{4}$	..	..	..
21	3	8	39	M	4	$4\frac{3}{4}$	$11\frac{3}{4}$	$15\frac{1}{2}$	19	..	..	..
$15\frac{1}{2}$	1	12	47	M	2	5	12	..	..	..	..	..
$18\frac{3}{4}$	2	12	42	M	2	$5\frac{1}{2}$	15	..	..	..	..	..
14	0	12	28	F	2	7	$12\frac{1}{4}$	..	..	..	..	..
15	1	8	45	M	2	4	11	..	..	..	..	..
10	0	8	51	F	1	$4\frac{1}{2}$	..	..	..	..	..	..
$10\frac{1}{2}$	0	9	49	F	1	5	..	..	..	..	..	..
$19\frac{1}{2}$	3	0	41	M	4	$5\frac{1}{4}$	$11\frac{1}{2}$	$15\frac{1}{2}$	$17\frac{1}{4}$	..	..	..
18	2	8	43	M	3	$6\frac{1}{4}$	$11\frac{3}{4}$	15	..	..	..	..
20	2	12	35	M	4	$5\frac{3}{4}$	$11\frac{1}{2}$	13	18	..	..	..
$18\frac{1}{2}$	2	8	40	F	4	$5\frac{3}{4}$	11	15	17	..	..	..
$17\frac{1}{2}$	2	4	43	M	4	5	12	15	16	..	..	..
$17\frac{1}{2}$	2	0	37	M	4	$3\frac{3}{4}$	$9\frac{3}{4}$	14	16	..	..	..

TABLE D (HUTT RIVER).

Length.	Weight.	C.F.	Sex.	Age.	Calculated Length, in Inches, at End of Winters.					
					1.	2.	3.	4.	5.	6.
(a) Season 1927–28.										
In.	lb. oz.									
15 ..	1 10	48	?	3	5·7	10·6	13·5	..	..	..
14 ..	1 4	46	?	3	4·4	7·5	11·2	..	..	..
15½ ..	1 8	41	?	4	6·2	8·5	12·9	14·5	..	..
15 ..	1 6	40	?	3	4·7	8·3	11·4	..	..	..
18½ ..	2 2	34	M	5	4·7	8·3	12·6	14·5	17·3	..
16 ..	1 2	28	M	3	5·4	10·7	14·8	..	..	..
15½ ..	1 4	34	?	4	3·5	7·8	11·6	13·0	..	..
15 ..	1 4	37	M	3	5·7	11·0	13·7	..	..	..
14¾ ..	1 2	35	F	3	3·6	8·2	10·3	..	..	..
14 ..	1 4	45	M	3	3·5	6·7	11·7	..	..	..
16 ..	1 8	37	F	4	3·9	8·6	11·5	13·6	..	..
19½ ..	3 0	42	M	5	3·8	8·2	12·0	14·6	18·0	..
14¾ ..	1 5	41	M	2	6·5	10·6	..	..	..	..
15½ ..	1 8	40	F	4	3·3	6·6	10·5	14·0	..	..
15 ..	1 4	37	F	3	3·7	7·3	12·4	..	..	..
15 ..	1 4	37	F	3	3·3	7·4	12·7	..	..	..
15 ..	1 4	37	F	3	5·9	8·2	12·2	..	..	..
15¼ ..	1 4	35	F	3	6·2	11·6	13·0	..	..	..
15¾ ..	1 8	39	M	3	5·8	9·2	13·2	..	..	..
16½ ..	1 11	38	?	4	4·6	8·8	12·3	14·7	..	..
13½ ..	1 10	64	?	5	3·4	6·2	10·2	13·2	13·5	..
14½ ..	1 4	42	M	4	3·0	6·8	9·2	18·0	..	..
14½ ..	1 6	45	?	3	4·3	7·8	11·8	..	..	..
13½ ..	1 1	44	?	3	5·8	8·5	11·2	..	..	..
15½ ..	1 10	44	?	4	3·9	7·3	11·6	14·2	..	..
(b) Season 1928–29.										
16½ ..	1 14	42	M	3	5·6	11·2	15·2	..	..	..
17¼ ..	1 15	38	M	3	4·2	12·0	16·0	..	..	..
15 ..	1 5	39	F	3	4·7	9·9	12·4	..	..	..
11¾ ..	0 12	46	F	2	3·9	8·2	..	..	..	..
21 ..	3 0	34	M	6	4·4	9·0	12·7	15·5	18·2	20·0
14½ ..	1 4	41	M	3	5·5	9·0	12·5	..	..	..
16¼ ..	1 9	37	M	4	3·6	8·8	12·0	14·4	..	..
15½ ..	1 5	35	F	2	6·6	12·4	..	..	..	..
16¾ ..	1 12	37	M	4	4·6	8·9	13·2	15·4	..	..
15 ..	1 4	37	F	3	6·1	10·8	13·0	..	..	..
18½ ..	2 4	36	F	4	3·7	8·5	11·0	16·4	..	..
12½ ..	0 14	46	M	2	4·6	8·9	..	..	..	..
16½ ..	1 11	38	F	3	5·0	7·2	12·4	..	..	..
16 ..	1 12	43	M	4	3·2	6·8	12·5	14·8	..	..
17 ..	2 0	41	M	5	3·8	9·7	12·5	14·5	16·0	..
16½ ..	1 8	34	F	3	4·1	9·1	13·1	..	..	..
17 ..	1 10	33	M	3	5·7	10·2	13·4	..	..	..
15 ..	1 0	30	M	3	3·9	9·5	13·8	..	..	..
12 ..	0 11	40	M	2	4·8	9·5	..	..	..	..
11½ ..	0 11	44	..	2	4·0	6·8	..	..	..	..
18¾ ..	3 7	53	M	4	4·3	8·7	11·0	14·3	..	..
14¾ ..	1 4	39	M	3	4·8	8·3	12·0	..	..	..
16¼ ..	1 9	37	F	3	4·0	6·9	12·8	..	..	..
14¾ ..	1 4	39	F	3	4·1	9·8	12·7	..	..	..
14½ ..	1 6	45	?	3	3·9	7·6	11·3	..	..	..
15¾ ..	1 9	40	F	3	5·0	7·1	14·1	..	..	..
11½ ..	..	..	..	2	4·5	8·3	..	..	..	..
11¼ ..	..	..	M	2	5·4	9·2	..	..	..	..

TABLE D (HUTT RIVER)—*continued.*

Length.	Weight.	C.F.	Sex.	Age.	Calculated Length, in Inches, at End of Winters.					
					1.	2.	3.	4.	5.	6.
				(c) Season 1929–30.						
In.	lb. oz.									
15 ..	1 2	33	M	4	3	$5\frac{3}{4}$	10	$12\frac{1}{4}$	..	..
15 ..	1 2	33	F	4	$4\frac{1}{4}$	7	$9\frac{3}{4}$	$13\frac{1}{4}$	..	..
$19\frac{1}{2}$ ..	2 1	28	M	4	5	$8\frac{1}{4}$	$13\frac{1}{4}$	$17\frac{1}{2}$	..	..
$16\frac{3}{4}$ ..	1 12	38	F	3	5	$11\frac{1}{4}$	$14\frac{3}{4}$	..	..	..
$15\frac{3}{8}$ ..	1 4	35	M	2	7	$12\frac{1}{4}$	..	..	..	..
$15\frac{1}{2}$ ..	1 6	37	M	2	$4\frac{1}{2}$	13	..	..	..	..
$15\frac{1}{2}$ ..	0 14	24	M	3	$4\frac{1}{2}$	$7\frac{1}{2}$	$13\frac{1}{4}$	..	..	..
13 ..	0 14	41	F	3	$4\frac{3}{4}$	$8\frac{1}{4}$	$11\frac{1}{4}$	..	..	..
$11\frac{1}{2}$ ..	0 9	37	M	2	$3\frac{3}{4}$	$6\frac{1}{2}$	..	..	..	..
$13\frac{1}{4}$ ..	0 14	38	F	3	4	$8\frac{1}{2}$	11	..	..	..
$14\frac{1}{2}$ ..	1 $0\frac{1}{2}$	34	F	4	$4\frac{3}{4}$	$7\frac{1}{4}$	$11\frac{1}{4}$	13	..	..
$14\frac{1}{2}$ ..	1 1	35	M	3	$5\frac{1}{2}$	$7\frac{1}{2}$	$12\frac{1}{4}$	..	..	..
$14\frac{1}{2}$ ..	1 1	33	M	3	$4\frac{3}{4}$	$9\frac{1}{2}$	12	..	..	..
$15\frac{1}{2}$ ..	1 3	32	M	3	$4\frac{3}{4}$	8	$12\frac{1}{4}$	..	..	..
15 ..	1 3	35	F	2	$6\frac{3}{4}$	$11\frac{1}{4}$	..	..	..	..
$16\frac{3}{4}$ ..	1 7	31	F	5	$3\frac{3}{4}$	7	$11\frac{1}{4}$	$13\frac{3}{4}$	$14\frac{3}{4}$	..
13 ..	0 13	38	?	3	$3\frac{1}{2}$	$7\frac{1}{2}$	$11\frac{1}{2}$	..	..	..
12 ..	0 11	40	M	3	$4\frac{3}{4}$	$6\frac{3}{4}$	$10\frac{1}{2}$	..	..	..
$14\frac{1}{2}$ ..	1 1	35	M	3	$3\frac{3}{4}$	$6\frac{3}{4}$	$11\frac{1}{2}$	..	..	..
$12\frac{1}{2}$ ..	0 12	39	F	3	$3\frac{3}{4}$	$7\frac{1}{4}$	$11\frac{1}{4}$	..	..	..
13 ..	0 12	35	F	3	4	$8\frac{1}{2}$	$11\frac{3}{4}$	..	..	..
15 ..	1 $0\frac{1}{2}$	31	M	3	$6\frac{3}{4}$	$8\frac{1}{2}$	$12\frac{1}{2}$	..	..	..
16 ..	1 8	37	F	4	$5\frac{1}{2}$	$8\frac{1}{4}$	$11\frac{1}{2}$	14	..	..
$15\frac{1}{4}$ ..	1 6	39	F	3	$4\frac{1}{4}$	$8\frac{1}{4}$	$12\frac{1}{4}$	..	..	..
$17\frac{1}{2}$ ..	2 0	38	F	4	$6\frac{1}{4}$	9	$14\frac{1}{2}$	$16\frac{3}{4}$	..	..
17 ..	2 4	46	F	4	5	$7\frac{1}{2}$	$12\frac{1}{2}$	$14\frac{3}{4}$	..	..
$15\frac{3}{8}$ ..	1 7	40	F	3	$4\frac{3}{4}$	$7\frac{3}{4}$	$10\frac{1}{2}$	..	..	..
$15\frac{1}{4}$ ..	1 7	40	M	3	$5\frac{3}{4}$	$9\frac{1}{2}$	$11\frac{3}{4}$	..	..	..
18 ..	2 0	35	M	5	$3\frac{1}{2}$	$6\frac{3}{4}$	11	$14\frac{1}{2}$	$16\frac{3}{4}$	..
16 ..	1 3	29	M	5	4	8	$10\frac{1}{2}$	$12\frac{3}{4}$	15	..
15 ..	1 2	33	F	4	$3\frac{1}{2}$	$6\frac{3}{4}$	$9\frac{1}{2}$	$11\frac{3}{4}$	..	..
$16\frac{3}{4}$ ..	1 8	32	M	4	$4\frac{3}{4}$	$8\frac{1}{4}$	$10\frac{3}{4}$	14	..	..
15 ..	1 2	34	F	4	5	$7\frac{1}{4}$	$10\frac{1}{4}$	13	..	..
$14\frac{1}{2}$ ..	1 1	35	M	3	5	8	$11\frac{1}{2}$	..	..	..
$18\frac{3}{4}$ ..	2 4	34	F	5	$5\frac{1}{2}$	$10\frac{3}{4}$	$13\frac{1}{2}$	$16\frac{1}{4}$	18	..
$14\frac{1}{2}$ ..	1 0	33	?	3	$5\frac{1}{4}$	$8\frac{3}{4}$	11	..	..	..
16 ..	1 6	34	M	4	$3\frac{3}{4}$	$7\frac{1}{2}$	$11\frac{1}{2}$	$14\frac{1}{2}$	..	..
14 ..	1 1	39	F	3	$5\frac{3}{4}$	$9\frac{1}{4}$	$11\frac{3}{4}$	..	..	..
$12\frac{1}{2}$ ..	0 11	35	F	3	$3\frac{1}{2}$	8	11	..	..	..
$12\frac{1}{2}$ ..	0 11	35	M	3	$4\frac{3}{4}$	8	$11\frac{3}{4}$	..	..	..
$15\frac{3}{4}$ ..	1 7	37	F	3	$5\frac{1}{4}$	$9\frac{1}{2}$	$12\frac{3}{4}$	..	..	..
16 ..	1 8	37	F	3	$5\frac{1}{2}$	$10\frac{1}{2}$	$13\frac{3}{4}$	..	..	..

PHOTO. 1.—Scale of brown trout, taken on the 5th December, 1929 (during its third summer), from the Lower Selwyn River.

Length, 11½ in. Weight, 9 oz. Growth type, IIA.

PHOTO. 2.—Scale of female brown trout, taken on the 2nd November, 1929 (during its third summer), from the Lower Selwyn River.

Length, 11½ in. Weight, 12 oz. Growth type, IIA.

PHOTO. 3. — Scale of brown trout, taken on the 5th December, 1929 (during its fourth summer), from the Lower Selwyn River.

Length, 16½ in. Growth type, IIB.

PHOTO. 4.—Scale of female brown trout, taken on the 2nd April, 1930 (during its fifth summer), from the Aparima River, Southland.

Length, 18½ in. Weight, 2½ lb. Growth type, IA.